OSGOOD & COMPANY • INDUSTRIAL DRAWING FOR BEGINNERS

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*FOR SCHOOL AND HOME USE.*

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# INDUSTRIAL DRAWING

## FOR BEGINNERS.

## FREE-HAND.

NUMEROUS GEOMETRICALLY PROPORTIONAL EXERCISES, AND OTHERS
FROM NATURE, SYSTEMATICALLY ARRANGED, ILLUSTRATING
PRINCIPLES OF PRACTICAL DESIGN, AND WELL CALCULATED TO TRAIN THE EYE AND HAND, TO
STRENGTHEN THE MEMORY AND JUDGMENT,
TO CULTIVATE THE TASTE, AND TO
DEVELOPE THE IMAGINATION
AND THE INVENTION.

DEC 5 1916
PATENT OFFICE

THE MORE OF AN ARTIST THE BETTER THE ARTISAN.

BOSTON:
JAMES R. OSGOOD AND COMPANY,
(LATE TICKNOR & FIELDS, AND FIELDS, OSGOOD, & CO.)
1872.

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# PREFACE.

Drawing will never find an uncontested place in the common schools, and successfully maintain it, until, in its earlier stages, — beyond which few boys and girls will advance, — it meets, in large measure, the views of three parties, — the party who demand of education direct, practical results; the party who regard training, discipline, as the most essential element of education; and the party who are specially concerned about artistic culture. The results, therefore, to be sought in elementary drawing, are practical, disciplinary, and æsthetic. In the preparation of this little book, these three objects have been kept in view.

The text explains, while numerous examples illustrate, the four kinds of drawing known as Linear, Orthographic Projection, Isometric Projection, and Pictorial Projection, or Perspective. The first acquaints the pupil with the drawing of flat surfaces and of irregular surfaces treated as though they were flat. The second acquaints him with the drawing of solids as they are, not as they appear, and with the general construction of working-drawings, which do not give a picture of the object. The third acquaints him with the drawing of solids at a particular angle; which gives at once both a picture of the object as it is and a working drawing. The fourth acquaints him with the drawing of objects as they appear when the eye is at a limited distance. The text explains, also, a number of the more important principles of design. Occasional drawings from nature, though, with slight exception, foreign to the main industrial object of the book, are introduced for the purpose of giving greater variety, stimulating observation, and illustrating, to a limited extent, the way in which such drawings are made. To Shading and Perspective very little space is allotted, because they are of little or no practical value, and because any extended and satisfactory application of the principles on which they are based would be too difficult for a book of this character, or for free-hand practice alone. They, with dependent Model Drawing, belong to a later stage. This initial work is broad, not special, which it should be to meet the wants of the great body of the people.

The drawings in this book, even from the outset, illustrate some of the generally accepted laws of design. No time whatever is devoted to the meaningless drawing of lines; the pupil discovers at once a purpose in his work, and so is pleased and stimulated. When he has obtained a knowledge of laws, no matter how few, he should be required to invent designs illustrating what he has learned. He should not, however, be encouraged to invent, except he does understand the laws, as he will work at random, and will be very apt to produce vicious designs. The farther he advances, the more he may originate, because he will do it with more understanding. If he originates, while going through this book, fifty designs illustrating its principles, there will be healthy development of his inventive faculties.

Observant teachers are aware that easy problems are much better than difficult ones to illustrate the principles of arithmetic; they are also aware that these principles cannot be firmly fixed in the mind, and facility in their application secured, without the solution of a great number of problems. The same is true of drawing; and the exercises in this book have been arranged largely with reference to that fact. They are numerous, and will be found of easy execution from first to last, if taken in their order. With few exceptions, there is a logical dependence among them all, which makes their execution of much less difficulty than seems possible at first view. Pupils ten or twelve years old can do them all, and most of them two or three times, in two hundred hours.

It is held that all ornamentation should be based upon a geometrical construction; that every assemblage of forms should be arranged on certain definite proportions; that the whole and each particular member should be a multiple of some simple unit. Now, the greater part of the drawings in this book have definite proportions; and so they can, in complying with this general law of the Decorative Arts, be readily enlarged, and should be when done by the pupil. This will add to the beauty of most of them.

The working with dots, as is systematically done in this book for the first time, we believe, harmonizes with the true principles of design as established by the ancients and followed at the present day. Oftentimes a large number of lines cutting each other at right angles or obliquely are employed as a foundation on which to construct the design. But in this book a few points instead are selected from the many which would result from the intersection of numerous lines; and, by the aid of these, wonderfully-varied figures are constructed. Every thing is simplified, confusion vanishes, and children have a method of work adapted to their capacity.

The text contains directions, usually facing the drawings, for the execution of each drawing. As a result of the peculiar method of the book, these directions are very brief, yet explicit. To these special directions others of a more general character are added, with questions by way of review, for the purpose of calling attention repeatedly to the more important things. Thus the book is complete in itself, not only affording work to be done, but showing how and to what purpose it is to be done. Any active, intelligent teacher, though unacquainted with drawing, can use the book successfully, teaching himself and leading his pupils. And it is the regular teacher who must teach drawing, if ever introduced generally into the common schools. Any intelligent mother, willing to give twenty minutes every day to the direction of her child in drawing, can also use the book with most satisfactory results. There is now altogether too little home instruction of children.

One of the most essential things, while it is one of the most difficult, for pupils to acquire, is the ability to distinguish clearly the exact force of the printed word. There are several things which have a tendency to keep school-children from acquiring this power. But we will not particularize.

So far as pupils in the public schools have been instructed in drawing, the instruction has come directly from the living teacher, and has not tended to give them the mastery of the printed word, nor to increase their self-reliance. Now, this need not and should not be. If this book is used according to its intention, the pupil, provided he is equal to the second reader, will be assigned drawing lessons to be studied and executed by himself. If he can make out and will follow the printed directions, doing just what they tell him to do, he will obtain the required result. If he fails to apprehend the meaning of the words, that failure will appear in the drawing, and he will see it for himself. There can be no mere memorizing of words, as in nearly all other studies, without comprehending what they mean. Again, those slow to learn will be better able to give the necessary time to their work; for when the pupils are obliged to rely wholly upon the instruction given by the teacher to the class, the dull ones must soon fall behind, or those quick to learn must be kept back. Nor will there be opportunity, as in other studies, for the indolent to shirk; for the drawings are all to be preserved, if done on paper, with name and date added, until the end of the term: if done on slate or blackboard, until inspected by the teacher. The work will show for itself whether it has been done with care or not.

The time for the drawing-lesson arrives: some one of the pupils reads the directions; the teacher then sends a part of the class to the blackboard, while the others work on their slates or on paper, as they may be equipped. With the progress of the lesson the teacher criticises, questions, and, if needful, illustrates on the blackboard. In case the pupils work too rapidly, and therefore carelessly, he leads on the blackboard, requiring them to do just what he does, and to do it together. With pupils too young to study the printed directions, he must, of course, always lead. The pupils should be required to criticise the work done by one another; while, from time to time, each, working on the blackboard, should lead the class.

For the younger pupils the lessons should be about one-half hour long; for older pupils this time should be extended somewhat. When drawing is taught at all, the lessons should occur every day, not once or twice a week: alternate terms better than alternate days. Children, like other live people, hate dawdling, and prefer to make a business of whatever they do. There is no good reason why drawing should be studied every term. Where schools continue most of the year, it is, indeed, believed that nothing would be lost, but much gained, if many of the studies were occasionally dropped for three months at a time. With the younger pupils, and perhaps with the older, it is probable that fifty hours devoted to drawing in one hundred consecutive days would give a result as good as one hundred hours in one hundred consecutive weeks, with average age.

While this book is adapted to beginners in any school whatever, it is more especially designed for schools below the grammar grade, and for the lower classes in that grade. When desired, the first one hundred and eighteen exercises can be had by themselves, for the use of the youngest pupils. Also, when desired, the drawings can be had on cards.

Boston, August, 1872.

# INDUSTRIAL DRAWING.

## EXERCISE 1.

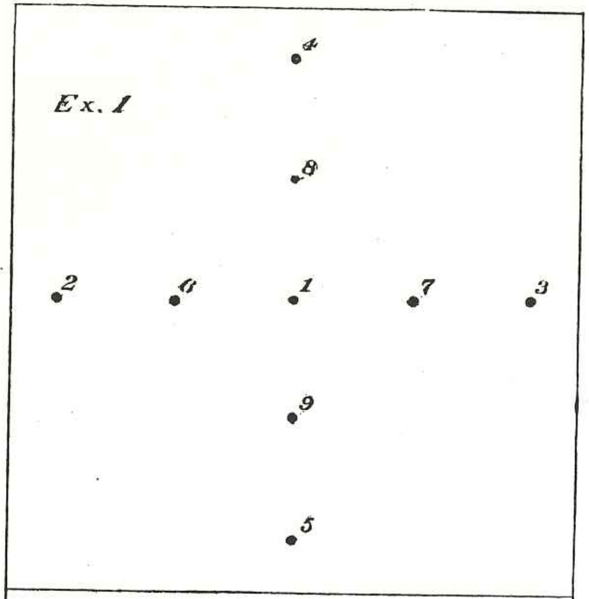
### Nine Dots. Halves.

A point has no magnitude; it is position only, and invisible. A dot, having magnitude, is not, strictly speaking, a point, but is used to indicate where a point is. In order to do the drawings in this book, the relative position of certain points must be known first; and dots are used to represent these points. The word point may be regarded as more elegant than the word dot; but it is thought best, in these exercises, to employ the latter. The teacher will see that the pupil clearly understands the difference between the words, and what the service is that the dot really performs.

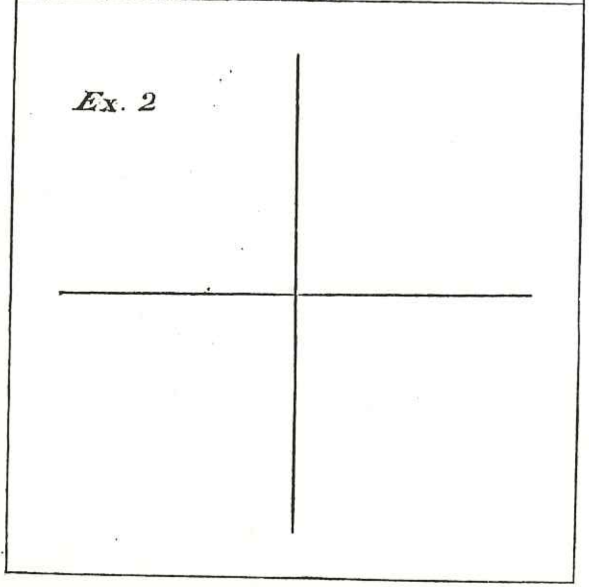
Make the dots of this exercise in the exact order of the figures. If a slate is used, make dot 1 in the centre of it; if paper, make the dot in the centre of the sheet, or of that part of the sheet allotted to the exercise. This will train the eye to judge of position. If a blackboard is used, make dot 1 exactly on a level with the eye, as the eye should be against the centre of the drawing; otherwise it cannot judge correctly of its proportions. Make dot 2 at any convenient distance to the left of dot 1, with suitable allowance for margin, which should vary somewhat with drawings of different sizes. Also make dot 2 in the same level line with dot 1. Make dot 3 in the same level line with the first two dots, and just as far to the right of dot 1 as dot 2 is to the left. Study carefully the position of these dots before making others. This will train the eye to judge of level or horizontal direction, as the dots must be made in the same level line; also to judge of relative distance, as the two spaces between the dots must be compared with each other and made equal.

Make dot 4 directly above dot 1, and as far from it as dot 2 is from it. At the same distance from dot 1, and directly below it,

Ex. 1



Ex. 2



make dot 5. This will train the eye to judge of up and down or vertical direction, and to compare vertical with horizontal distance. The beginner will be apt to get the vertical distance too short by about one-quarter; for the reason, probably, that the eyes are in a horizontal line. Study carefully the position of these dots, making them again and again, if needful; for it is of the utmost importance that these five, since they form the basis of so many of the drawings in this book, should be accurately placed. If paper or a slate is used, hold it vertically in front of the eye, turning it about for better examination; if a blackboard is used, stand a few feet from it, with the eye exactly in front of the centre dot. The pupil will be best able to judge of the direction of the dots and of the spaces between them, when his eye is at a sufficient distance to take them all in at once, — at least three to five times the distance from dot 2, on the left, to dot 3, on the right. Finally, make dots 6, 7, 8, and 9, placing them so as to halve the spaces between the dots already made. When done, the nine dots should form two straight rows, — one horizontal, the other vertical, while the spaces between the dots should all be equal. Bear on lightly when making the dots.

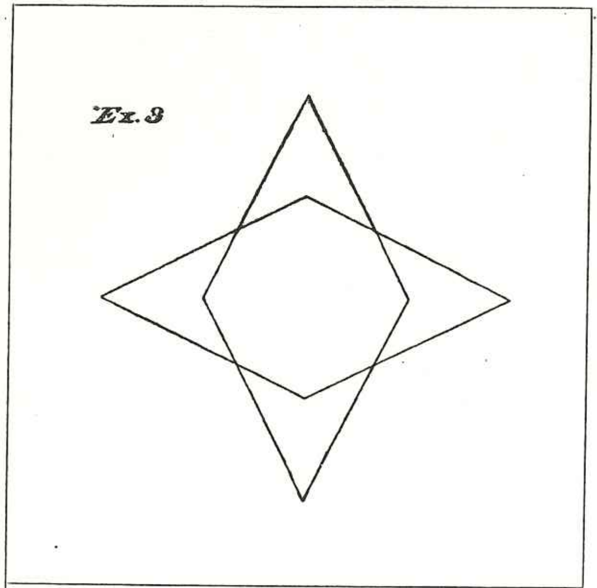
This simple yet difficult exercise teaches five valuable things, —

1. Position.
2. Direction.
3. Distance.
4. Margin.
5. Division of Spaces into Halves.

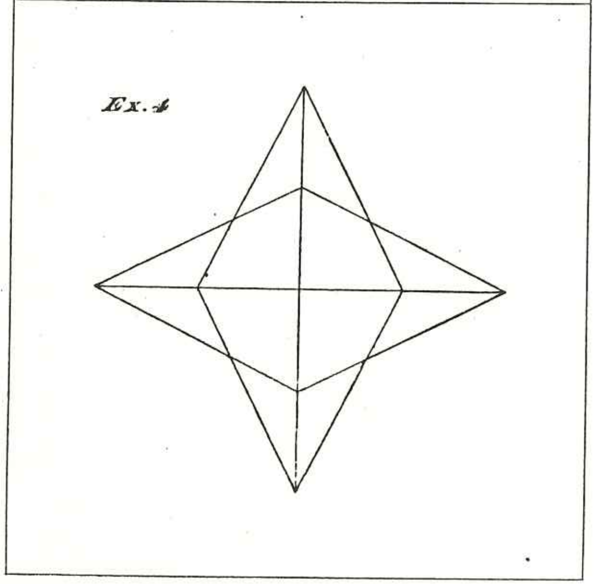
Beginners should do this exercise several times, remembering always to make the dots in the exact order of the figures. Young beginners cannot do the exercise the first time in less than twenty minutes, and be properly instructed as to the manner of doing it, and what it teaches. They will need not a little practice before learning to make the dots with sufficient deliberation.

**Ex. 2.** Erect Cross. — A line has no thickness, only length: think of a point as moving, and its path will form a line. This is the line of geometry, not the line of common speech. The latter is only a mark to indicate the place of the former, as the dot indicates the place of the point. A right line as it is called in geometry, or a straight line as it is called in common speech, is the shortest line between two points.

Begin by making nine dots, just as in Ex. 1. Since the dots this



Ex. 3



Ex. 4

time are to serve only as guides in drawing the lines, make them small enough not to show after the lines are drawn. Draw the lines from dot to dot, when they will be straight or crooked, according as the dots have been properly placed or otherwise. Draw the horizontal line from the left dot towards the right; draw the vertical line from the top dot towards the bottom. In addition to what is taught by Ex. 1, the pupil will learn from this exercise to draw a right or straight line from one dot to another, which is not an easy thing for the beginner, young or old.

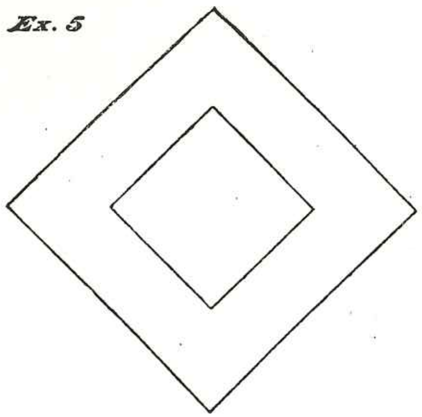
All straight lines are not drawn alike. In order to draw one to hit a given dot or point, as in the present case, — and this is the kind of line which must usually be drawn, — do not look at the pencil or crayon, nor at the line drawing, but rather at the dot which it is desired to hit. Hit it, too, whether the line drawn be straight or crooked. When a carpenter drives a nail, he does not look at his hammer, but at the nail-head; when a boy knuckles down at taw, he does not look at the marble in his hand, but at the one he wishes to hit. Just so, in drawing a straight line to hit a given dot, look at the dot and not at the pencil. All beginners are inclined to do the opposite; the teacher, therefore, must give special attention to this matter.

Before touching the paper with the pencil, or the blackboard with the crayon, carry the pencil or crayon two or three times slowly over the space where the line is to be drawn: this will give the direction of the line. Then make a light sketch, as seen in Ex. 7. Usually there is no objection to a light unbroken line for a sketch; but, as a broken line is often employed for other purposes, it is well for the pupil to learn to make it now.

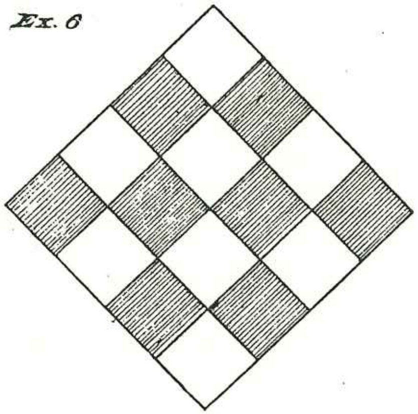
Having got a satisfactory sketch, make the line heavy, taking particular care to draw it with a slow, uniform movement. Never allow the pencil to move faster than the eye or mind; otherwise the line will be drawn at hazard. When a sketch has been made, of course it is simply necessary to follow that in finishing the line. See that the hand does not obstruct the vision. When done, the line should be of the same size its whole length. To make it thus, it will often be necessary to strengthen parts of the line with an extra touch of the pencil. As to color, the line should be gray rather than black.

In order to draw a right or straight line from one dot or point to another — 1st, Carry the pencil over the space two or three times without touching the paper; 2d, Sketch the line very lightly, look-

*Ex. 5*



*Ex. 6*



ing at the point it is desired to hit; 3d, Draw the full line with a slow, uniform motion, following the sketch; 4th, Do not let the hand obstruct the sight; 5th, Make the line of the same size throughout its whole length; 6th, Make it gray rather than black.

**Ex. 3.** TWO RHOMBS, OR DIAMONDS. — The rhomb has four equal sides, but unequal angles. Opposite angles, however, are equal. Observe that these two rhombs are twice as long as wide. Begin these two rhombs or diamonds by making nine dots, as in Ex. 1; then sketch all the lines, just as in Ex. 7, before finishing any one of them. When doing this, or any of the other exercises, it will be well, in order to learn to draw straight lines in all directions, not to turn the slate or paper, except for the purpose of examining the work. By not turning the slate or paper, the pupil will learn from this exercise to draw oblique or inclining lines,—a thing it is essential he should learn to do with ease. If the blackboard is used, he will be obliged, as that cannot be turned, to draw his lines obliquely.

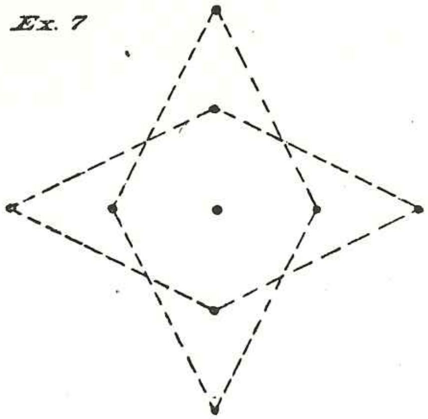
**Ex. 4.** This combines the three preceding exercises, and teaches whatever they teach, and something more. Begin with nine dots, as in Ex. 1; sketch all the lines, before making any one of them heavy; then finish, taking particular pains to make smooth work wherever the lines join or cross. Make good joints always. Where three lines unite, this is not so easily done.

**Ex. 5.** TWO CONCENTRIC SQUARES. — The square is a figure which has four equal sides enclosing four right angles. The right angle is equal to one-quarter of a circle, as the teacher will show the younger pupils.

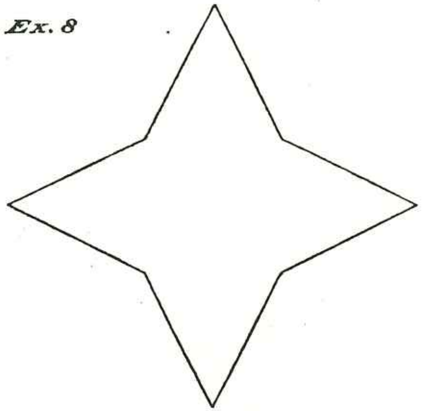
Begin the drawing of these two squares, which have the same centre, and so are called concentric, by reproducing Ex. 1. Sketch the smaller square first, joining the dots next the centre; then sketch the larger square, joining the outer dots. See that each square is not only perfect in itself, but that the corresponding sides of the two squares are parallel. Finish in full line.

**Ex. 6.** SIXTEEN SQUARES, EVERY OTHER SHADED. — Make a sketch of two concentric squares, as in Ex. 5; extend the sides of the inner square until they cut the sides of the outer square; then sketch two lines through the centre. Having thus made a sketch of the sixteen squares, finish them in heavy line, and shade as in the example; which, it need hardly be said, has no reference to actual

*Ex. 7*



*Ex. 8*



shadow. The tint or shade lines should be fine, parallel, close together.

It will please the younger pupils, if occasionally permitted to use colored pencils and crayons, coloring the squares variously instead of shading them. It may be well, perhaps, to grant this as a special favor to only those who strive to do their work neatly.

**Ex. 7.** Sketch of Two Rhombs. — This sketch is the first step in doing the exercise that follows. The lighter it is made, the better, provided only it can be seen.

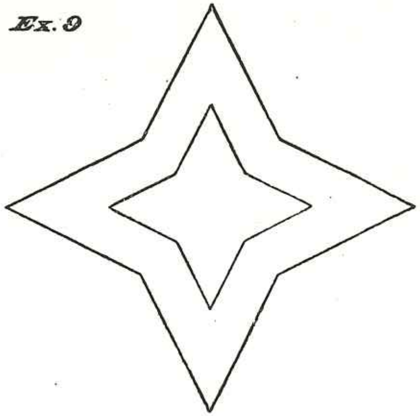
When making a sketch, either a broken or continuous line — never dots — should be used. The pencil should be carried steadily forward and quite rapidly, touching the paper at intervals (for a broken line), but never stopping; just as a ball, when thrown horizontally, skips along the ground, touching it at intervals but, never stopping until its force is spent. Beginners are apt to sketch with a jerky movement, advancing a little, and then returning. This must not be permitted. Nor must the pupil, when working on a blackboard, be permitted, for the purpose of steadying his hand, to touch the board with hand or arm; otherwise, he will fail to acquire freedom of movement. When drawing short lines, however, on paper or a slate, the hand may be steadied in any convenient way, as there is need of using the fingers only.

**Ex. 8.** Star made from Two Rhombs. — Make a sketch, as in Ex. 7. Erase what is inside the points where the lines cross; finish the remainder in heavy line.

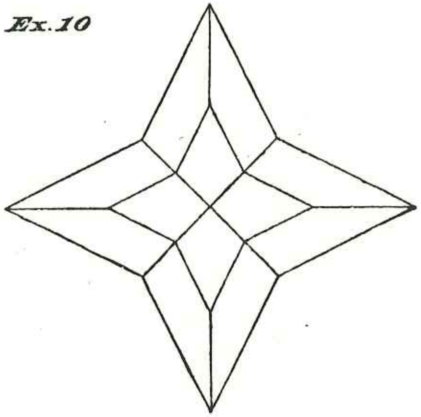
It is often necessary to sketch lines not required when the drawing is done. They help greatly in drawing the lines which are required. When erasing a line, touch the paper very lightly, and rub one way only, — not first one way, then another. Remove with the breath or soft piece of cloth the particles of paper as they are loosened. When the erasing needs to be done with special care, as when lines are close together, cut a small hole of diamond shape in a piece of paper; lay this over the drawing, and erase through it.

Questions. — What is a point? Difference between a point and a dot? How should a dot be made? Where should the first dot be made, on the slate? On paper? On the blackboard? What is meant by horizontal direction? By vertical direction? How far should the eye be from the drawing, to judge easily and correctly of all its proportions? To what mistake is one liable in comparing

Ex. 9



Ex. 10



vertical with horizontal distance? Name the things taught by the first exercise.

**Ex. 9.** Double Star. — Make a sketch, as in Ex. 7; then add four dots, halving the spaces around the centre dot, and sketch two more smaller diamonds or rhombs. Erase, and finish as in Ex. 8. Do not draw any of the lines heavy until all have been sketched.

**Ex. 10.** Begin by making the sketch for the last exercise, and then sketch the additional lines required for this figure. Finish.

It will be observed that all the drawings, thus far, have been made from the nine dots of the first exercise, except the addition of four dots in the last two exercises. These are but a few of the many drawings which can be made from the same nine dots. The pupil, taking these dots for a basis, should be required to produce at least one original drawing. More would be better, as it would give valuable exercise to his inventive faculties, which it is so essential to stimulate and develop.

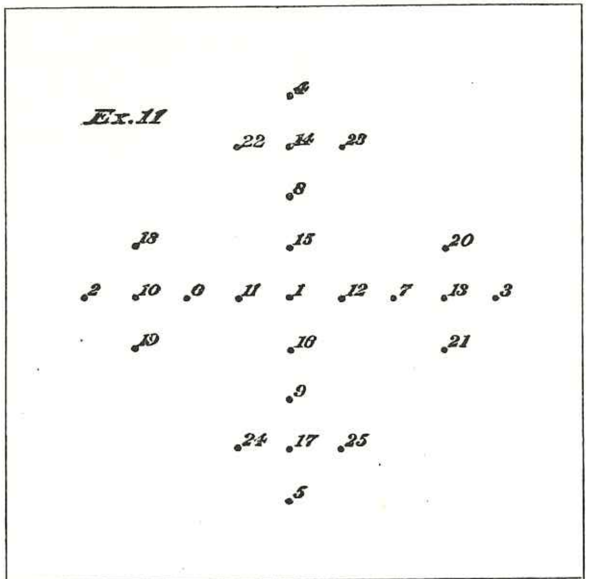
These simple drawings illustrate two foundation principles of industrial design. They have definite mathematical proportions. Starting with a given unit of distance, — the distance between dots 1 and 2, or dots 2 and 6, for example, — the length of each line is dependent on that. Again, their parts are so balanced that no one line can be removed without destroying the harmony of the design. There is nothing superfluous. Try the experiment with the last exercise. Erase any one line, the harmony is gone: erase all its corresponding lines, the harmony is restored; but it is a new design.

If the pupil will examine the covers of books, carpets, wall-paper, cast-iron fences, the ornamentation of cars, he will see abundant application of these principles.

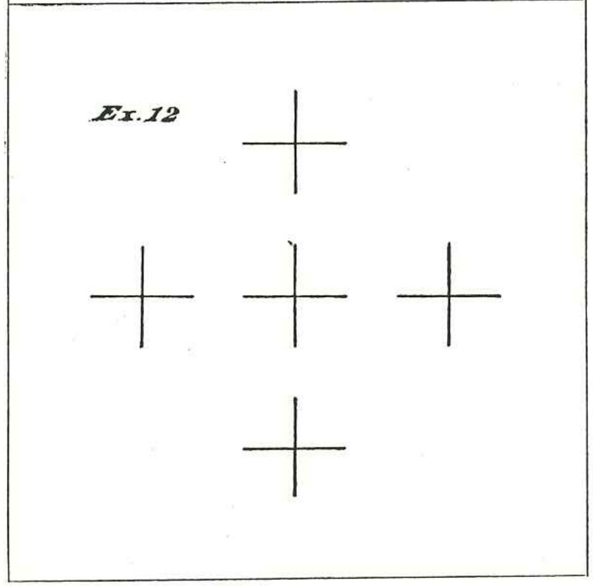
Questions. — What is a line? A right line? What should one look at when drawing a right line to hit a given point? How should the hand move? What is said of sketching a line? Of finishing? Of size and color?

Since, in drawing, lines must be made in all directions, there can be no fixed position for holding the pencil. This is the general rule. Never permit the hand or pencil to come between the eye and paper where the line is to be drawn. To secure this open field, the hand and pencil may be turned and put in any position, provided that it is an easy position, allowing the fingers, especially, to move with freedom. The pencil should always be of good length, grasped lightly, with the fingers about two inches from the point.

*Ex. 11*



*Ex. 12*



**Ex. 11.** Twenty-five Dots. Quarters. — Having made the first nine dots, as in Ex. 1, halve all the spaces from left to right, from top to bottom, and then add the side dots. This will divide into quarters the original space between dots 1 and 2. Whenever these dots are to be made, follow the exact order of the numerals. This order can be easily memorized, and if memorized will render the progress of the pupil much more satisfactory. See that all the spaces between the dots are equal; that dot 18, for instance, is just as far above dot 10, as 15 is above 1. See that dots 2, 18, 22, 4, for instance, are in a straight line. Other dots are in other straight lines. By thus studying their relative position, the dots can all be correctly located.

Before making a dot, consider well where it should be made; much erasing may thus be avoided. There must be no measuring except with the eye, in doing this or any of the other exercises; nor any use of a rule in drawing the straight lines, nor of compasses in drawing the curves. Remembering it is a chief object of these exercises to train the eye and hand, the teacher must see that these directions are strictly followed.

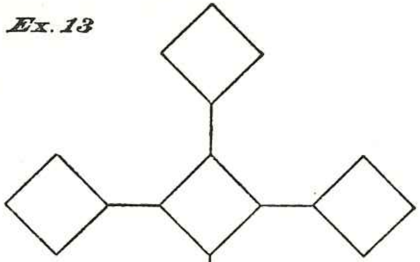
Questions. — What is a rhomb? What is an oblique line? Spell oblique. Why is it not best to turn the slate or paper, when drawing oblique lines? How should the pencil be held? Where should one begin to draw a horizontal line? A vertical line? Should this rule always be followed?

**Ex. 12.** Five Erect Crosses. — Begin with twenty-five dots, as in Ex. 11. Sketch all the crosses before drawing any one of them in heavy line. See that they are all of just the same size, that the central vertical, or up and down lines, form parts of one straight line, while the central horizontal, or level lines, form parts of another straight line. The pupil must carefully avoid erasing any of the dots while sketching, or he will often be obliged to begin anew.

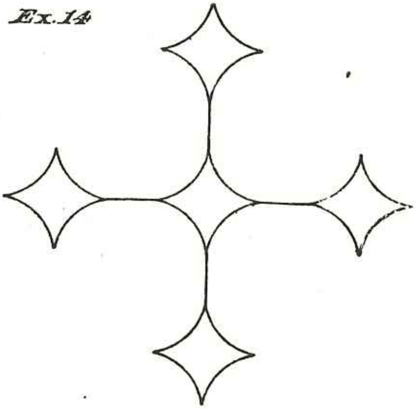
**Ex. 13.** Five Squares United. — Reproduce Ex. 11; sketch and finish, observing to make good joints and all the squares of just the same size.

Beginners will usually prefer to draw a heavy line at once. This they must not do; for a heavy line, if drawn incorrectly, is not only more difficult to erase than a sketch, but the erasure is apt to spoil the beauty of the drawing. A light sketch, while it serves to show the outline and proportions of a drawing, is easily removed when incorrect. Lightness of touch must also be secured soon as

*Ex. 13*



*Ex. 14*



possible: sketching tends to give this. It is no easy task to learn to sketch with satisfaction. At the outset, there must be constant practice, the pupil never allowed to make a drawing in heavy line without first sketching it. After a season, however, he should be frequently required to do the exact opposite; that is, to make his best possible line the first time, and to complete his drawing without erasure or correction of any kind whatever.

It will usually be found best not to erase a wrong sketch or a wrong dot until the right one has been made, as the wrong will serve as a guide in making the right. We improve not only by imitating the virtues but by shunning the faults of others. A straight line is to be sketched between two points: the first trial gives a crooked result; do not erase, and the second must give a better.

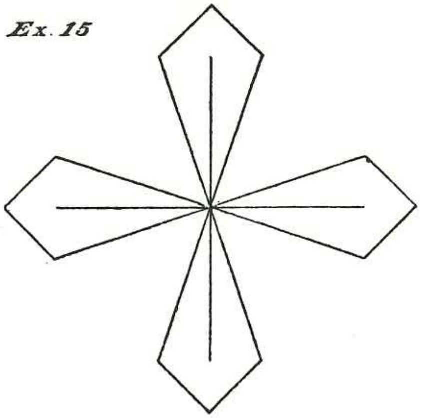
The pupil should be provided with a good eraser. Some erasers are designed for pencil, others for ink; while there are still others designed for both, having their ends unlike. Since the pupil should draw a part of the time with pen and ink, for the purpose of learning to be careful, if for nothing else, it would be well for him to have the eraser last mentioned.

QUESTIONS. — How should the pencil move when sketching? What is said of erasing an inaccurate dot or line, before making another? What is said of working without erasing at all? Why not steady the hand against the blackboard? What may be done about it, when drawing on paper?

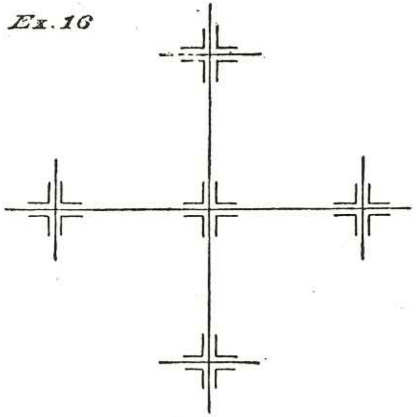
**Ex. 14.** FIVE CONCAVE FIGURES UNITED. — Reproduce Ex. 11; sketch and finish. Having drawn the first curved line, giving it any degree of curvature, compare all the others with that as the standard, making them just alike. If the pupil compares each curve with the one last made, and not with the one first made, he will easily perpetuate and increase any departure from the standard. The teacher must insist upon the pupils comparing each curve with the standard, then all the curves with one another. This will train the eye, and at last make the drawing of curves an easy matter.

**Ex. 15.** Begin with twenty-five dots, as in Ex. 11. See that the four lines running from side to side are straight, and cross each other at exactly the same point. When more than two lines unite or cross each other at the same point, there must be special care in drawing the lines.

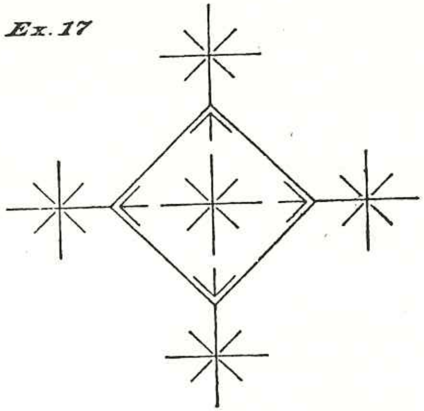
*Ex. 15*



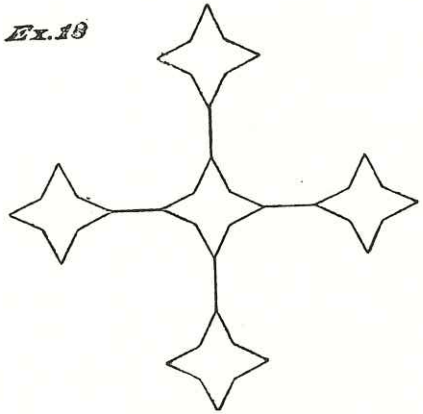
*Ex. 16*



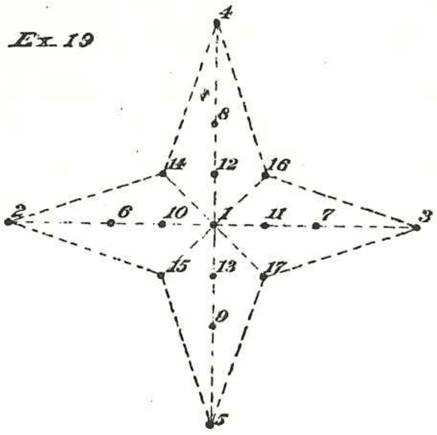
*Ex. 17*



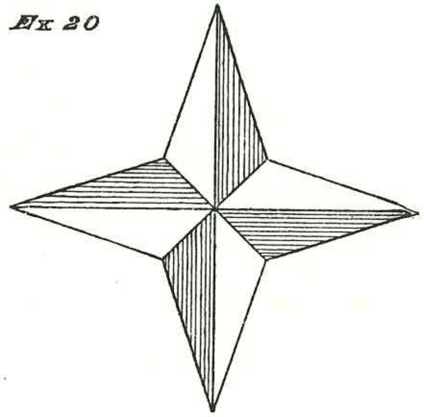
*Ex. 18*



Ex 19



Ex 20



**Ex. 16.** Ornamented Cross. — Reproduce Ex. 11, and finish carefully.

**Ex. 17.** Ornamented Square and Cross. — Reproduce Ex. 11; sketch and finish. Colors can be readily used.

**Ex. 18.** Five Stars made from Rhombs. — Begin by making twenty-five dots, as in Ex. 11. Add other dots, halving the four spaces around the middle dot and around each of the dots next the end. Around each of these central dots, sketch two rhombs or diamonds, as in Ex. 7. Unite, and finish. Do this exercise on a large scale. It will be seen, that, instead of the star, we may use either of the drawings thus far made.

**Ex. 19.** Sketch of Four-Pointed Star. — Reproduce Ex. 1; then make dots 10, 11, 12, 13, halving the spaces around dot 1; next, place dots above and below dots 10 and 11, and as far from them as dots 12 and 13 are from 1. Sketch. This goes with the next exercise.

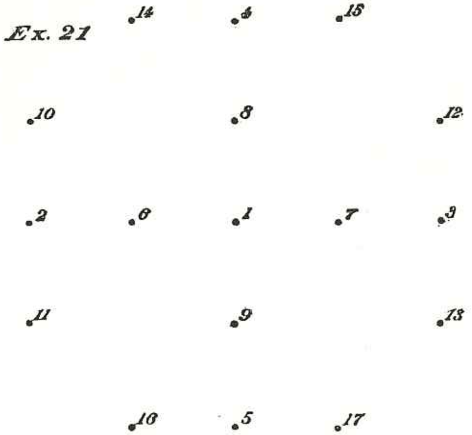
**Ex. 20.** Four-Pointed Star. One-Half Shaded. — Make a sketch like that of the preceding exercise. Shade with fine parallel lines, shading not with reference to light and dark. The younger pupils, in particular, will be pleased to use colored pencils, or crayons, instead of shading. Do several times.

With one-half hour of judicious instruction each day, the younger pupils should be brought to this point in four or five weeks; the older pupils in two or three. If they have learned to make the first nine dots with a good degree of accuracy; if they have learned to sketch with a light touch, and draw with considerable ease a straight line; if they have learned to proceed deliberately, and to do their work with neatness, — then their future progress will be rapid and pleasant. If the things named have not yet been learned, there will still be ample opportunity to learn them; but the sooner learned, the better.

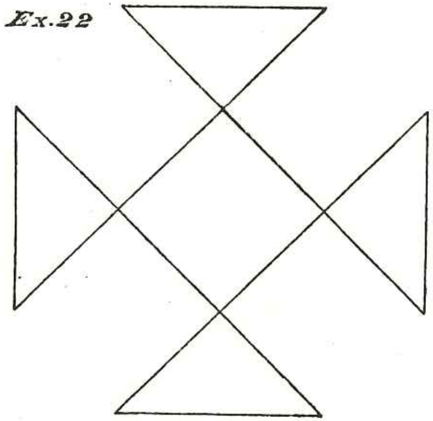
Questions. — How should a line be erased? What is said of sketching all the lines before drawing any of them heavy? What of sketching more lines than appear when the drawing is done?

**Ex. 21.** Seventeen Dots. — Reproduce Ex. 1. Place dot 10 as far above 2 as dot 8 is above 1. So with the other side dots. Dots 10, 8, and 12 should be in the same straight line; also dots 11, 6, 8, 15. Observe what other dots form other straight lines. By attend-

*Ex. 21*



*Ex. 22*



ing to the straight lines which the dots should form, it will not be a difficult matter to place them all properly.

It is now time that all pupils, even the youngest, began to use paper. For several weeks, quite young pupils will get on best with only the slate and blackboard. Indeed, it will usually be well for all to make the drawings the first time on the slate or blackboard. Drawing on different kinds of surface will afford a more varied discipline. An objection is justly made against a large use of the slate, that it perpetuates careless habits; because the drawings can be so easily erased and corrected that the pupils will seldom try to do their best the first time. The teacher must attend carefully to this matter; causing the pupils to proceed deliberately, studying their work at every step, determining, accurately if possible, the position of dots and the direction of lines before they are made. Again, the pupils should be frequently exercised in making complete drawings without a single erasure from beginning to end. For this work, paper, pen and ink may be used to advantage.

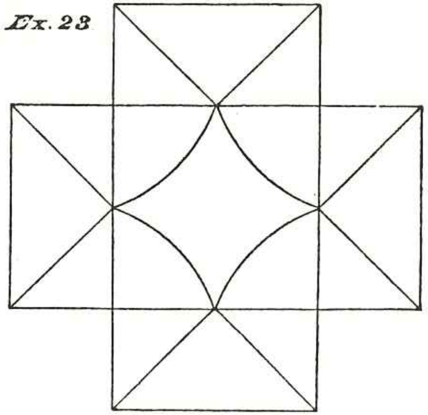
No mercy for carelessness, but always approval for every well-done. Remember, however, what would be ill-done for one pupil, because of age or capacity, would be well done for another, — a little child, for instance, — and should then be commended.

**Ex. 22.** Four Triangles and Square. — Begin by making seventeen dots, as in the last exercise. See that all the lines are straight, and all the triangles of the same size.

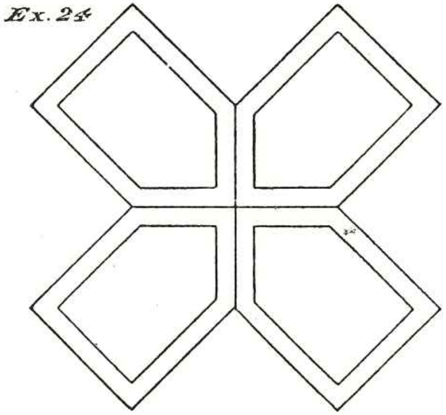
The triangle is a figure having three straight sides. The teacher may explain that there are four kinds. It is the strongest of all figures. Make its sides of three sticks united; and the shape of the figure, even though the joints be loose, cannot be changed without breaking one of the sticks. This is not true of any other figure, as may be learned by trial. For this reason, when it is desired to strengthen a building, its sides are cut into small triangles by the insertion of braces. For thousands of years, men have studied the triangle, and learned many wonderful things about it; yet it is probable there is a great deal more to be learned about this figure.

**Ex. 23.** Two Parallelograms. — Begin with the dots of Ex. 21. Connect the dots for the two parallelograms. See that the direction of the oblique lines is exactly from the corner of one parallelogram to the opposite corner of the other. See that all the curved lines have the same degree of curvature. Do the exercise several times.

Ex. 23



Ex. 24



All the exercises should be done frequently enough to enable the pupil to reproduce them with ease from memory. Teachers should see that the pupils read the directions carefully. Even quite small pupils should often be required to execute the drawings, the first time, by the aid of the directions alone. It will be found an excellent thing for teaching them the exact force of words.

Young pupils usually take great pleasure in drawing on the blackboard, provided they have a good one; and they should be permitted to do so frequently. As the blackboard cannot be turned, they necessarily learn to draw lines in all directions. They can also, as they should, make their drawings large. Because short lines are more easily managed than long ones, beginners are apt to make their drawings, whether on blackboard or paper, altogether too small.

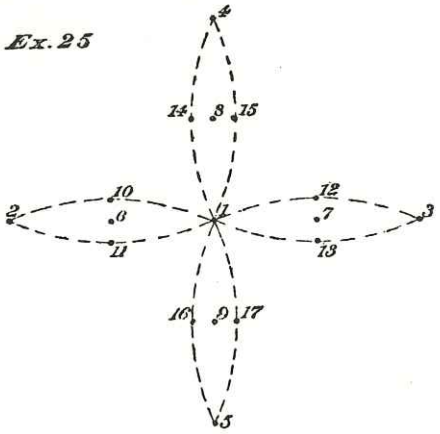
**Ex. 24.** Double-Line Figure. — Begin with the dots of Ex. 21. Sketch the outer lines first; then sketch the inner parallel to the outer. Finish. Make an original double-line figure.

The outer lines are drawn to hit a given point: how to draw them has been explained. But the inner lines are drawn parallel to the outer. Now, to draw one line parallel to another is a thing quite different from drawing a line to hit a given point. The eye must follow the pencil, not go before it, and must manage to look at both lines at once, — the line drawing, and the one to which it is to be drawn parallel. To draw a third line midway between two parallel lines and parallel to both, the eye must manage to look at all three lines at once. Only practice can give the knack of doing this. The teacher should give the pupil considerable practice in drawing parallel lines, short and long, straight and curved, without the use of guide dots; practice on slate, paper, and blackboard, — not all in a day, but a little during each of many successive days.

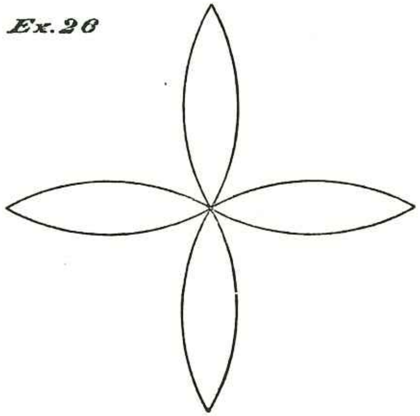
Pencils, whether lead or slate, should always be long and well-sharpened, with a nicely tapering point. Without a good point, a good line cannot be drawn. After the wood of a lead-pencil has been cut away with a knife, use a fine file to point the lead. For this purpose, a file is so much better than a knife, that the latter should never be used. Sand-paper answers very well. A very delicate point may be obtained by rubbing the side of the pencil against the drawing-paper, or any paper in common use.

**Ex. 25.** Four Ellipsoids Sketched. — Make nine dots, as in Ex. 1. Place the side dots at any equal distance from dots 6, 7, 8, 9,

*Ex. 25*



*Ex. 26*



giving the same width to all the ellipsoids. In sketching the curves, begin, for example, at dot 4, and pass down on either the right or left hand to dot 1, and thence, but on the opposite side, to dot 5. Beginning again at dot 4, sketch, in the same manner, a line to balance the first. The curves should exactly balance each other; that is, have just the same curvature in all their corresponding parts. In this way finish the sketch, making all the ellipsoids just alike, studying and changing the sketch until this result has been secured. This goes with the next exercise.

**Ex. 26.** Four Ellipsoids. — Make a sketch, as in Ex. 25. When drawing the lines heavy, do not stop at the centre, but continue on to the opposite side. The lines should all cross at exactly the same point. Do this several times. *O-i-d* at the end of a word means like or resembling. Typhoid-fever resembling the typhus, Ellipsoid resembling an ellipse, a figure to be described farther on.

Do not hesitate, even with small children, to use any word, like horizontal, vertical, oblique, triangle, parallelogram, whose meaning can be visibly illustrated. Children are not perplexed by merely long words, but by those of abstract character, whether long or short.

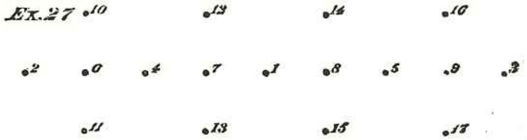
Questions. — What two principles of industrial design are illustrated by these drawings? Where may examples be found in actual practice? Will you make new designs illustrating these two principles, with any of the dots hitherto used.

**Ex. 27.** Seventeen Dots. Fourth Order. — Make the dots in the order of the numerals, with all the spaces between them equal. See that they form certain horizontal, vertical, and oblique straight rows, as they will if correctly placed. Observe that the arrangement of these dots is quite unlike that of any previous exercise, since their height is much less than their breadth. Starting from a given dot, other dots may be systematically and easily arranged about it, so as to give the basis of almost any proportional figure. What unlike figures may be made from the same dots has already been seen.

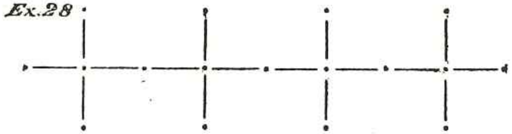
**Ex. 28.** Four Crosses made of Dots and Straight Lines. — Make the dots of the last exercise. See that the lines are all of the same length.

**Ex. 29.** Sixteen Ellipsoids United. — Begin with the dots of Ex. 27. Sketch the curves, as directed in Ex. 25, and finish as in Ex. 26. See that all the ellipsoids are of just the same size

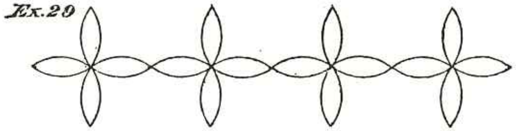
Ex.27



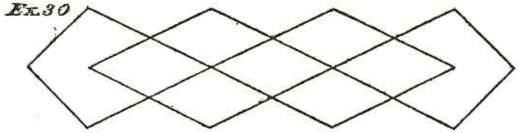
Ex.28



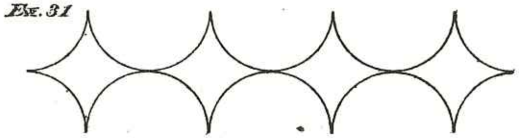
Ex.29



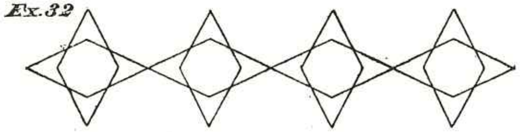
Ex.30



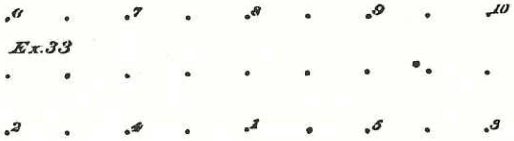
Ex.31



Ex.32



Ex.33



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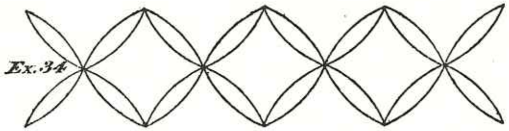

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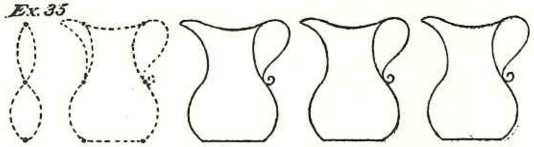
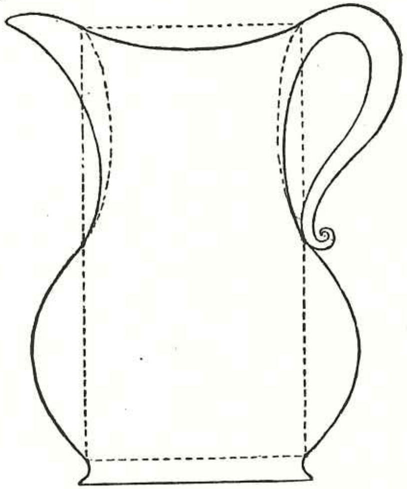
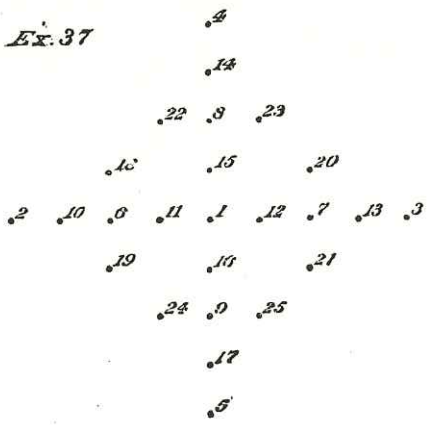


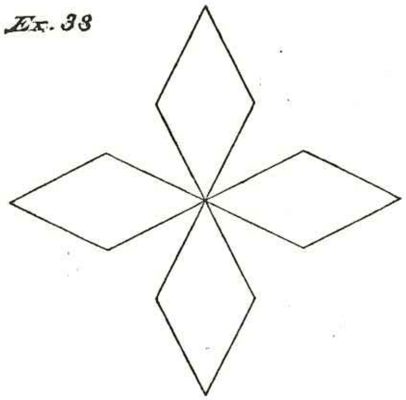
Ex.36



Ex. 37



Ex. 38



and shape. Carefully compare each with the standard and then with each other. Do this exercise several times, and on as large a scale as possible.

**Ex. 30.** Reproduce Ex. 27, and unite the dots as indicated. By adding to the dots, the length of this figure and of the others can be easily increased.

**Ex. 31.** Four Concave Figures United. — Reproduce Ex. 27. Strive to make all the curves just alike, comparing each with the standard.

**Ex. 32.** Four Pairs of Rhombs or Diamonds. — For these rhombs or diamonds, use the dots of Ex. 27. Make additional dots halving all the spaces around dots 6, 7, 8, 9. Finish as in Ex. 3. It will be well for the pupil to make an original figure, using the dots of Ex. 27 as the basis.

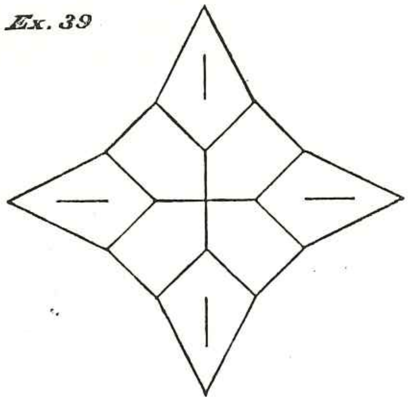
**Ex. 33.** Twenty-Seven Dots. — Make the dots in the order of the numerals, so far as the numerals extend. Then halve the spaces. See that all the spaces, horizontal and vertical, are made just equal.

It is much easier making a series of spaces equal by division than by addition; hence the pupil, at this stage of advancement, should not begin, for example, at dot 2, and proceed towards the right, adding one dot after another.

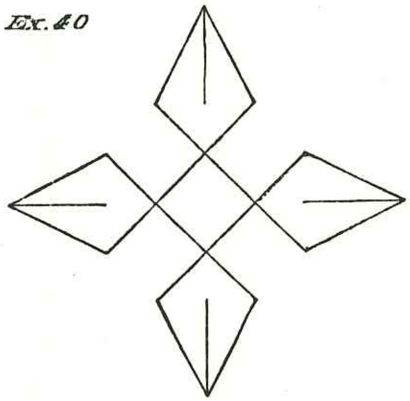
**Ex. 34.** Sixteen Ellipsoids. Oblique Order. — Reproduce Ex. 33. Sketch all the ellipsoids before finishing any one. Work from the left towards the right. Erase dots not covered by lines. It will be well for the pupil to increase the number of ellipsoids, which may be readily done by following the described mode of working.

**Ex. 35.** Four Pitchers. — Reproduce Ex. 33. Sketch all the pitchers before finishing any one. Work from the left towards the right. It is by comparing one pitcher with another, to see that they are all just alike, that the discipline is to be mainly got from this exercise. The teacher must constantly remind his pupils that careful comparison of corresponding parts and objects is a thing of vital importance. The purpose of this exercise, for example, is not the mere making of the pitchers, but the making of them just alike. Do the exercise several times, making the pitchers as large as circumstances will admit. The curves at the left are the curves used for the sides of the pitchers.

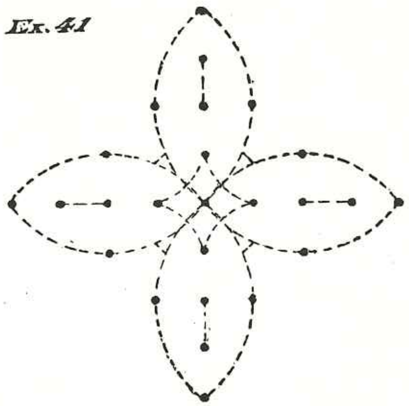
*Ex. 39*



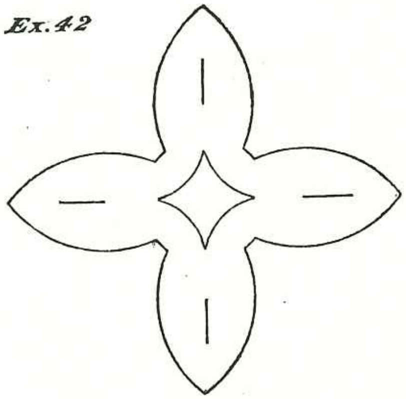
*Ex. 40*



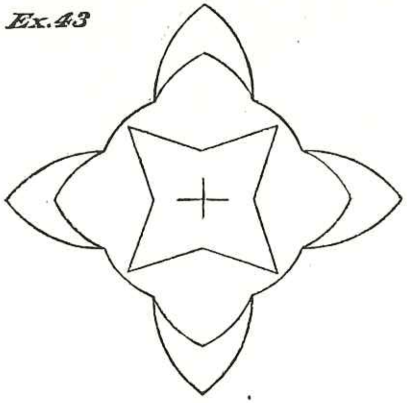
*Ex. 41*



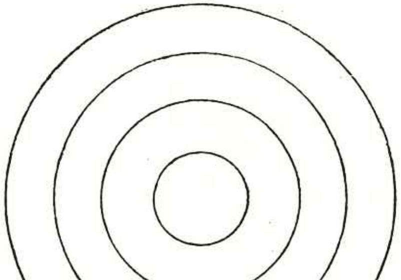
*Ex. 42*



Ex. 43



Ex. 44



**Ex. 36.** Single Pitcher. — Make six dots, and sketch the sides of a parallelogram through them. When the pitcher is done, this sketch to be erased. Any proportions may be taken for the pitcher. The height of the one in the example is one-half greater than the breadth of base. Draw a vase in like manner.

**Ex. 37.** Twenty-Five Dots. Second Order.— Be careful to make the dots in the exact order of the numerals. If pupils will do so with all the exercises, they will find no difficulty in memorizing the order of each set of dots, as one set naturally grows out of another. See that all the spaces between the dots are equal; that certain dots, as 18, 15, 20, and 18, 1, 21, and 18, 11, 16, 25, are in straight lines. Carefully observe the bearing of different dots.

**Ex. 38.** Four Rhombs United. — Begin with the last exercise as a basis. See that the lines cross each other at exactly the same central point. Erase dots not covered by lines.

**Ex. 39.** Same dots as in previous exercise. Make good joints. There will be some trouble in doing this, as there are so many places where three lines unite. Chance for colored pencils or crayons.

**Ex. 40.** Use the same dots for a basis as in the last two exercises.

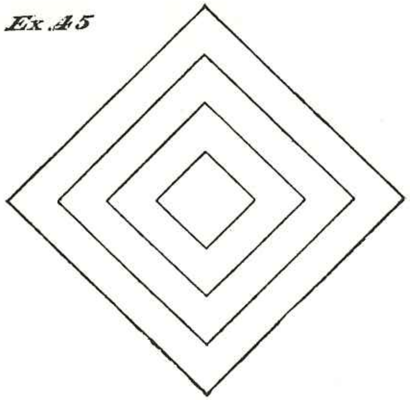
**Ex. 41.** Same dots as in the last three exercises. This sketch goes with the next.

**Ex. 42.** Make a sketch as in the previous exercise. Erase the parts not needed, and finish in even line.

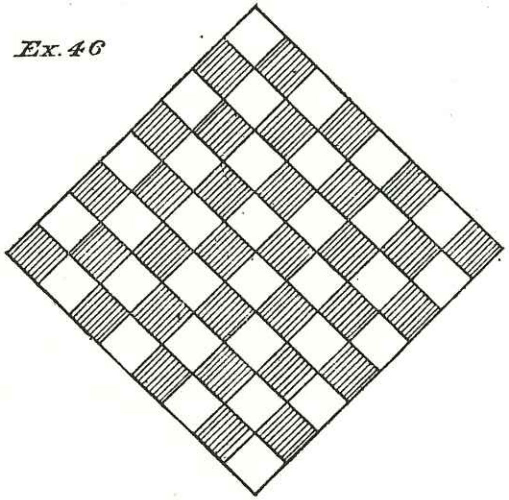
**Ex. 43.** Make twenty-five dots, as in Ex. 37; then four other dots half way between 18 and 22, 23 and 20, 21 and 25, 19 and 24. Sketch and finish. In this case, the sketching need not extend beyond the lines required in the finished drawing. Do this exercise several times, introducing parallel lines, as was done in Ex. 24.

**Ex. 44.** Four Concentric Circles. — Reproduce Ex. 1, and then halve each of the spaces, increasing the dots to seventeen. This will give the first seventeen dots of Ex. 37. Sketch all the circles, beginning with the smallest, and working outwards. Finish. Strive to make the circles not only exact in shape, but parallel and equidistant. It will be well for the teacher to have a pair of compasses with which to test the work of the pupils; but the pupils themselves should not be allowed compasses.

*Ex.45*



*Ex.46*



No one detects a slight imperfection in a circle so easily as in a straight line. For this reason, it is much more difficult drawing a true circle free-hand, as these should be drawn, than a straight line; since an imperfection which the eye fails to detect the hand can never correct. Though the pupil may draw straight lines well, he will not succeed with circles without much special practice.

The pupil should draw thousands of circles with a single steady stroke, sometimes using only the fingers, sometimes the whole arm. These circles should be made of all sizes. By diligent practice, he can make himself master of the circle as of the straight line. Remember the pencil must never outrun the eye or mind; otherwise, the lines will be drawn at random, with little or no good result.

QUESTIONS. — How are all measurements to be made, and lines drawn, when doing these exercises? When several curved lines or figures are to be drawn, how should they be compared? Why?

**Ex. 45.** FOUR CONCENTRIC SQUARES. — Make the first seventeen dots of Ex. 37, as when drawing the four concentric circles. Finish. See that the lines are parallel and equidistant.

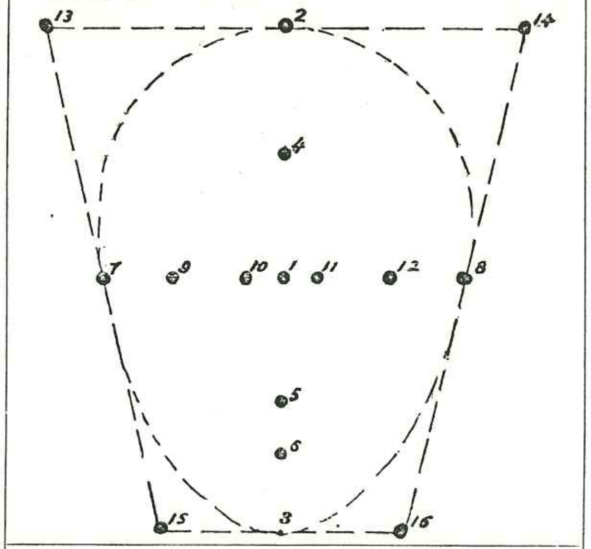
**Ex. 46.** CHESS BOARD. — Reproduce the sketch of the last exercise. Extend the sides of the inner squares until they cut the sides of the outer. Sketch two other lines, crossing each other at the centre. Finish. Compare with Ex. 6.

**Ex. 47.** DOTS MARKING THE PROPORTIONS OF THE HUMAN HEAD. — Make the dots in the order of the numerals. Dot 1 marks the root of the nose, which is just about the centre of the head. At any convenient distance above dot 1, place dot 2, and dot 3 at the same distance below. Halve these spaces with dots 4 and 5; the former marking the point where the hair begins, the latter the end of the nose. Below dot 5, and about two-fifths of the distance to dot 3, place dot 6, to show the position of the mouth. These dots give the vertical divisions of the head.

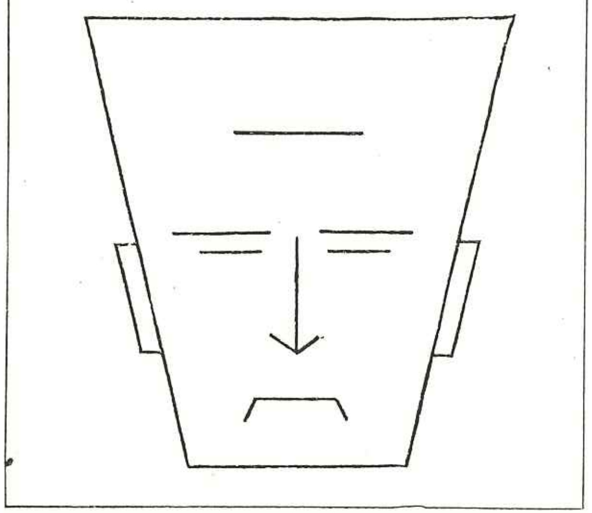
At the left and right of dot 1, place dots 7 and 8, one and a half times the distance from dot 1 to dot 3; which will make the head three noses wide, while it is four noses long. Divide the width of the head into five equal or very nearly equal parts, by dots 9, 10, 11, and 12. The eye occupies about one-fifth of the width of the head, and the distance between the eyes is about the same.

At the left and right of dot 2, and in the same level line, place dots 13 and 14, so as to mark something more than the greatest

Ex. 47



Ex. 48



width of the head. Place dots 15 and 16 on a level with dot 3; the former in a right line with dots 7 and 13, the latter with dots 8 and 14.

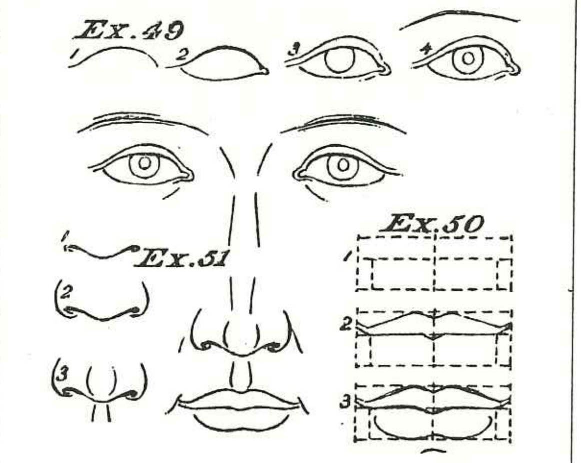
Having thus made the sixteen dots, sketch the straight lines that unite the outer ones. Next sketch the oval outline of the head By the aid of the straight lines, beginners even will find this quite easy to do. See that the oval is evenly balanced, one side just like the other, and that its width is greatest, by a trifle, just above dots 7 and 8.

These are not far from the average proportions of the human head, and will answer our present purpose much better than the minute subdivisions which would give the ideal head of the sculptor. The exercise should be repeated until these simple proportions are memorized; for it should be understood that each part of the body bears a nearly fixed proportion to all the other parts, and that without a knowledge of these proportions it is impossible to draw the whole, or even a head or hand, with any near approach to accuracy. The proportions, indeed, vary somewhat with different persons, and with the same person at different periods of life.

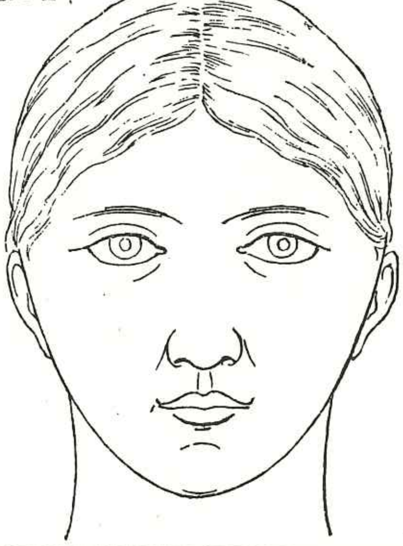
**Ex. 48.** The Square-Edged Man. — Make sixteen dots, as in the last exercise, and then draw the lines, beginning anywhere, — with the eye or nose, for example, or with the outline of the head. See that the head is evenly balanced, and that the ears are of the same length as the nose, and on the same level. Beginners are apt to place both the ears and eyes too high when they work without proportional measurements. Observe that the lines representing the eyes are drawn a little below the root of the nose, — a little below the dots that mark their width in Ex. 47.

**Ex. 49.** The Eye, Front View. — Here four steps are taken in drawing, rudely, a single eye. 1st. A line for the lower edge of the upper lid. 2d. An added line for the upper edge of the lower lid. Corner of the eye represented. 3d. Added line for upper edge of upper lid; also a circle for the iris, the upper part of which is hidden beneath the upper lid. 4th. Added line for the eyebrow; also circle for the pupil. Usually the iris, or dark part of the eye, touches the upper edge of the lower lid; but here the ball of the eye is represented as turned up slightly, showing a space between the iris and lower lid. The pupil should do this exercise many times, drawing both the right and left eye separately, and then together.

**Ex. 50.** The Mouth, Front View. — The width of the



Ex. 52.



mouth is a little greater than the width of the eye; that is, a little more than one-fifth of the width of the head. The thickness of the lips, from the upper boundary-line of the upper lip to the lower boundary-line of the lower lip, is about one-third the width of the mouth. The upper lip is somewhat thinner than the lower. We have then, in drawing, rudely, the mouth: 1st, Straight lines sketched to represent these general proportions. 2d, Added full straight lines for upper lip. 3d, Added curved lines for both lips. Erase the guide-lines. Observe the peculiar curves of the lines which bound the lips, and separate them. The pupil will need much practice before he can draw these lines readily.

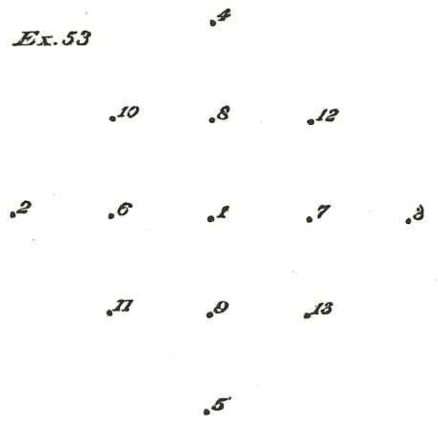
**Ex. 51.** The Nose, Front View. — The width of the lower portion of the nose is the same as the width of the eye. Vertical lines drawn downwards from the inner corners of the eyes will touch the outer edges of the nostrils. In drawing rudely the lower nose, we have, 1st, A curve for the tip of the nose and nostrils. Observe that the tip of the nose is lower than the nostrils, and that the lines for the nostrils curve under. 2d, Added lines for the wings of the nose. Observe that these also curve under. 3d, Added lines dividing the lower nose into three equal parts, — the middle and two wings; also lines to mark the channel below the nose.

In the drawing of the two eyes, nose, and mouth together, it will be seen that lines are added to mark the beginning or frontal section of the nose; farther down, other lines to mark the bony bridge; and then other and lower lines to mark the cartilagenous portion. The lines at the sides of the nostrils mark the beginning of the cheek; those at the sides of the mouth mark where its corners vanish in the cheek. There should be much practice in the simple outlining of these three most important features of the face. When the general outline fails, all fails.

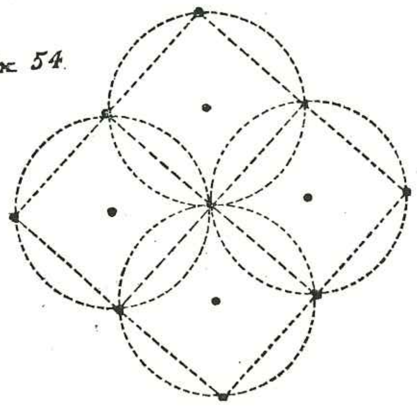
**Ex. 52.** Human Head, Front View. — Begin by reproducing Ex. 47. Having thus secured the oval for the head, draw the separate features, beginning with any one of them. See that each is given its proper place and size. There will be but little difficulty about this, if the previous four exercises have been well practised.

The teacher should insist that the pupils, when drawing the human head, observe carefully the heads of their school-fellows, and make measurements. It will be a pleasant surprise to most of them to learn that the eyes are in the middle of the head; that the head is four noses long, three noses wide, and that the ear is as long as

*Ex. 53*



*Ex. 54.*



the nose, and on a level with it when the head is erect. After the pupils have learned to draw with ease a head of given proportions, they should be required to vary these proportions, and to represent persons with whom they are acquainted. Study of pictures to be found in books and papers will show them what lines are used to denote laughter, grief, anger, and the other emotions. Details cannot be given in this book. Teachers will not keep their pupils beyond two or three days on the head, without advancing in the regular work of the book; but, from time to time, they should be required — or permitted rather, for they will delight to do it — to execute a head, in outline if nothing more.

It should be one of the leading aims of education to inculcate systematic, critical observation of nature, until it becomes a fixed habit with the student. He who goes through the world simply staring at it, is essentially blind. We make a good beginning at observation when we begin to observe ourselves. For this reason, also for the sake of variety, and because it will delight children especially, the single outline drawing of the human form, an ever-present model, finds a place in this book, although it is not strictly in keeping with the purpose of the book, which is industrial.

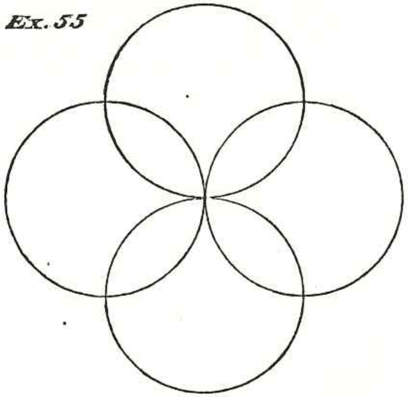
Questions. — Where is the centre of the human head, front view? How many noses long is the head? How many wide? How far from the end of the nose to the mouth? What is the width of the eye? Of the mouth? Of the lower nose? Distance between the eyes? Length of the ear? Its position? Name lines to be drawn to represent the eye. The mouth. The nose.

**Ex. 53.** Thirteen Dots. Second Order. — Begin by making nine dots, as in Ex. 1. Place the dots 10, 11, 12, and 13 at the same distance from 6, 7, 8, 9, that 8 is from 1. See that dots 2, 10, 4, are in the same straight line; also 4, 12, 3; also 3, 13, 5; also 5, 11, 2.

**Ex. 54.** Sketch of Four Circles Secant. — Begin with the dots of the last exercise. Sketch the lines forming the four squares. With the sides of these squares as guiding base lines, the circles can be easily sketched. Those who can make the circles without the aid of straight lines may of course omit the latter.

It will generally be found, that a straight base line is of service in drawing any curve whatever, and especially of service when two curves are to be drawn just alike. But more of this farther on.

*Ex. 55*



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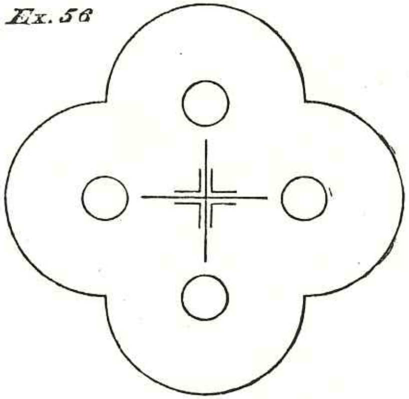


**Ex. 55.** Four Circles Secant. — Make a sketch as in the last exercise. Erase the straight lines, and finish. Do this exercise several times. Secant means cutting: it will be seen that these circles cut each other.

**Ex. 56.** Make a sketch, as in Ex. 54; erase the lines not needed, and finish. Repeat this exercise with border line double.

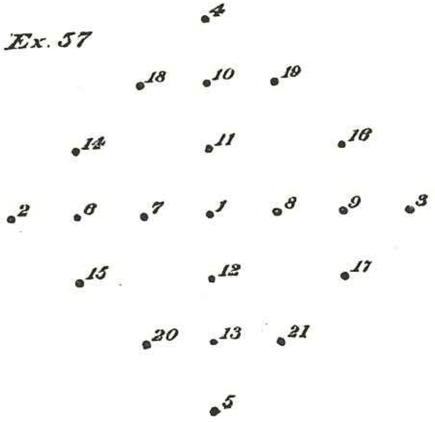
**Ex. 57.** Twenty-One Dots. Thirds. — Make the dots in the order of the numerals, with the spaces all equal; dot 14, for example, being made as far above 6 as dot 11 is above 1. See that dots 2, 14, 18, 4, also 15, 7, 11, 19, and others, form straight rows. This is our first exercise in dividing spaces into thirds. It will be found more difficult than dividing spaces into halves, since the eye must, somehow, look at and compare three spaces at once instead of two. Practice will give the knack of doing it.

When it is desired to divide a given line into nine equal parts, first divide it into three equal parts, and then each of these into three other equal parts. Starting with thirds, and continuing with thirds, we obtain ninths, twenty-sevenths, &c. Starting with halves, and continuing with halves, we obtain quarters, eighths, sixteenths, &c. Starting with halves, and continuing with thirds, we obtain sixths, eighteenths, fifty-fourths, &c. Starting with thirds, and continuing with halves, we obtain sixths, twelfths, twenty-fourths, &c. Starting with thirds, and alternating with halves, we obtain sixths, eighteenths, thirty-sixths, &c. If it is required to obtain a prime number of spaces, — 7, 11, 19, for example, — the spaces to be equal, yet of no particular length, assume any distance, as we have in our exercises thus far; divide that into a composite number of equal parts, and then add or take away from this number, as the case may require. For example, To obtain nineteen equal spaces, first obtain eighteen, as directed, and then add one; by taking away one, we have seventeen A prime number is a number, like 3, 5, or 7, which can be divided only by itself or 1. A composite number, like 4, 6, or 8, is a number which something besides itself or 1 will divide.

The teacher should frequently exercise his pupils, by question and application, in the subject-matter of the preceding paragraph. While imparting a knowledge of much service in practical drawing, it will prove an excellent drill in numbers.

**Ex. 58.** Four Crosses Ornamented. — Use the dots of the last exercise. Observe how the dots and lines of each cross bear with reference to the lines and dots of the other crosses.

*Ex. 57*



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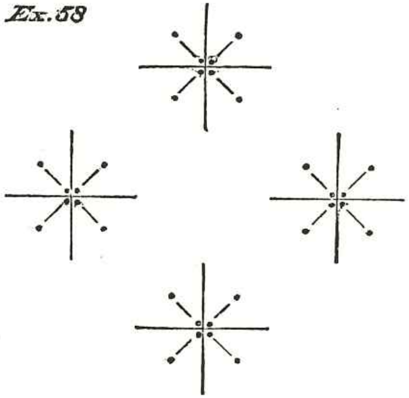

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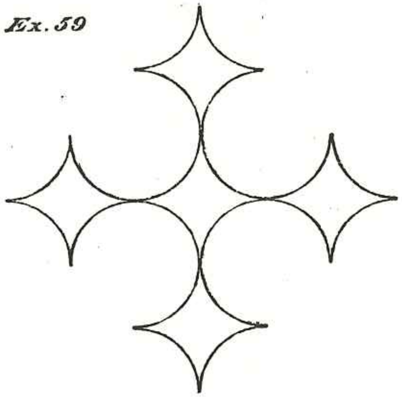

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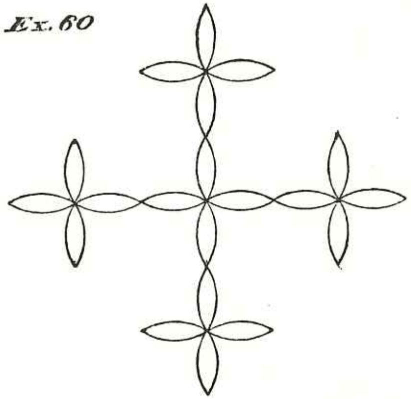

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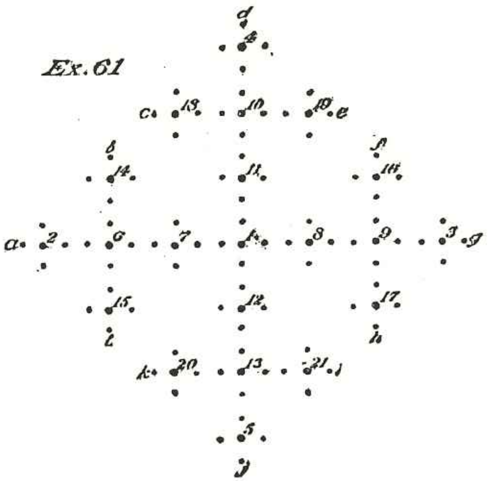

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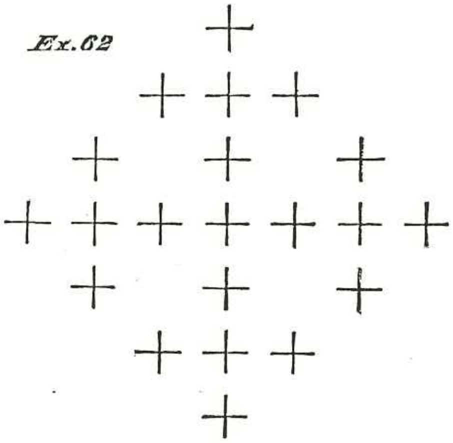


**Ex. 59.** Five Concave Figures Touching. — Use dots of Ex. 57. The curves are parts of circles. See that all are made just alike. Make good joints.

**Ex. 60.** Twenty Ellipsoids United. — The proportional base of this figure is given by the twenty-one dots of Ex. 57. Follow the directions already given for drawing similar figures. As this exercise should be done several times, it will be well to do it once or twice on the largest possible scale, since much training of the eye would be got from carefully comparing so many curves, in the effort to make them all just alike.

Questions. — What is a triangle? How many kinds? What is said of the triangle? What is a parallelogram? Spell the word. What is said of the pupils' doing the exercises by the aid of the book alone? Should the teacher be constantly helping the pupil?

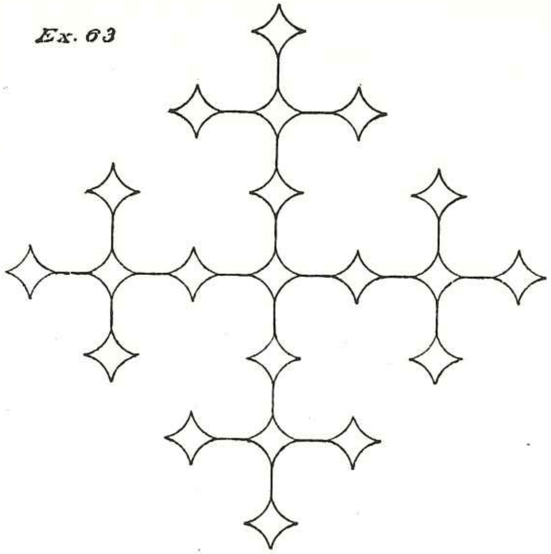
**Ex. 61.** One Hundred and Five Dots. — This is much the largest number of dots we shall have to make. By following the directions, there will be little trouble in making them. First make twenty-one dots, as in Ex. 57. These are the large dots of the example, and are numbered. Next divide each space between these dots into thirds. Next, beginning at the left, and going around in the order of the letters, add a dot to each extremity. Lastly add side dots enough for twenty-one crosses, the first twenty-one dots made being the centres of the crosses. It will be well for the pupil to practise this exercise until he can do it from memory. That will not take long; and it will well repay in training his eye and in teaching him to be careful. No measuring, remember, except with the eye.

**Ex. 62.** Twenty-One Crosses. — Begin by making the dots of the last exercise, and making them small. See that the crosses are all of the same size; that the lines intended to be vertical are vertical; that the lines intended to be horizontal are horizontal; that certain lines form parts of the same straight line. Note all these things carefully.

Questions. — What must you do, when drawing a straight line, to hit a given point? When drawing one line parallel to another? When drawing a third line parallel to the first two, and midway between them? You may now discover, if you can, how to draw a straight line when it is not desired to hit a given point.

**Ex. 63.** Twenty-One Concave Figures United. — Use

Ex. 63



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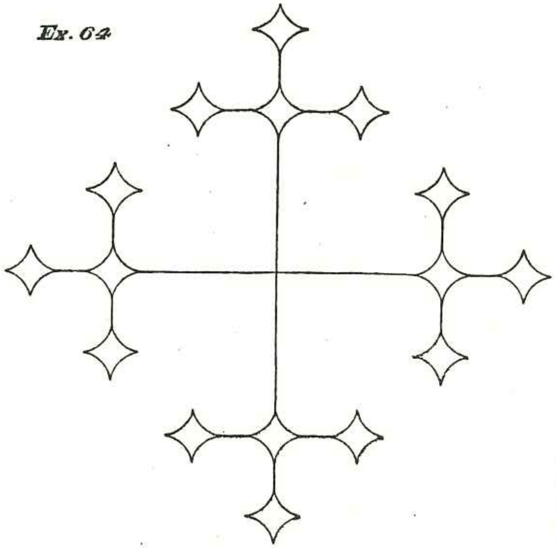

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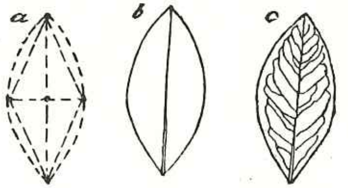

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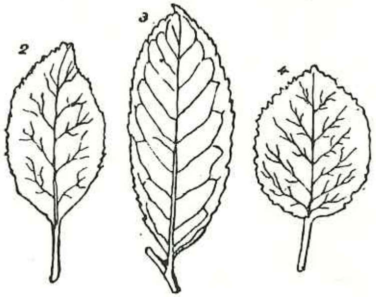

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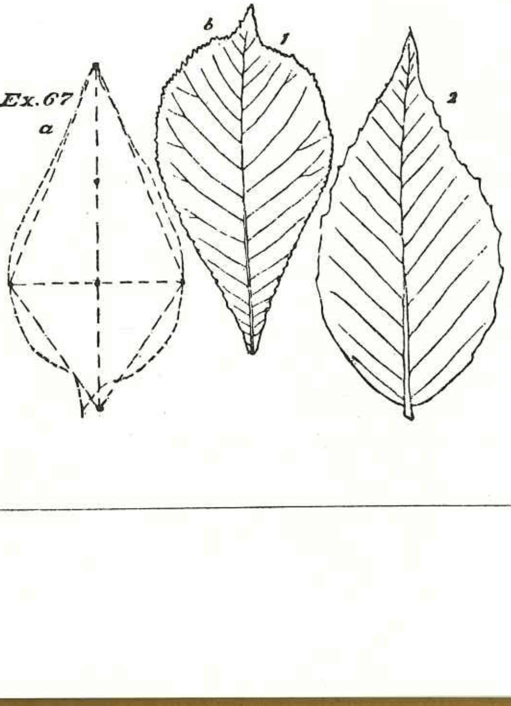
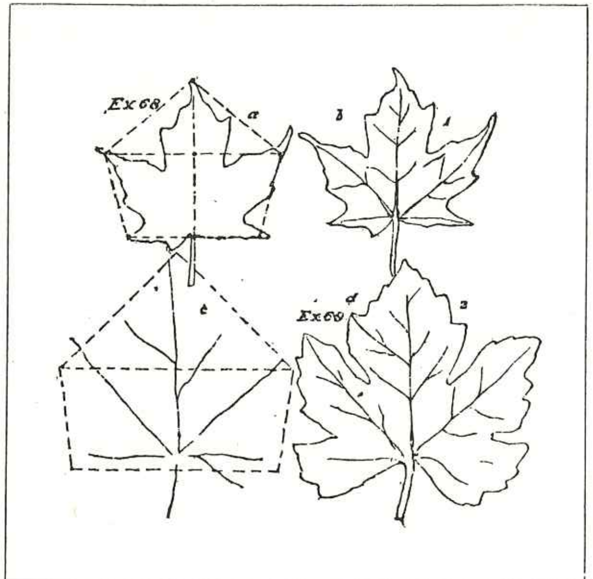
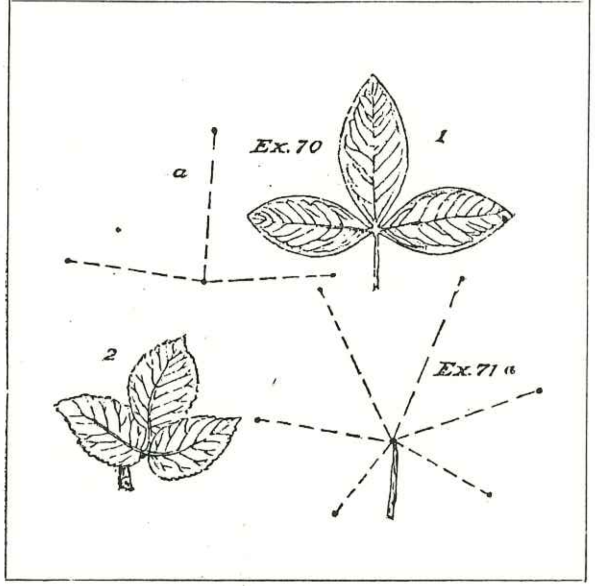






the dots of Ex. 61. Finish as in the example. Do on a large scale on the blackboard.

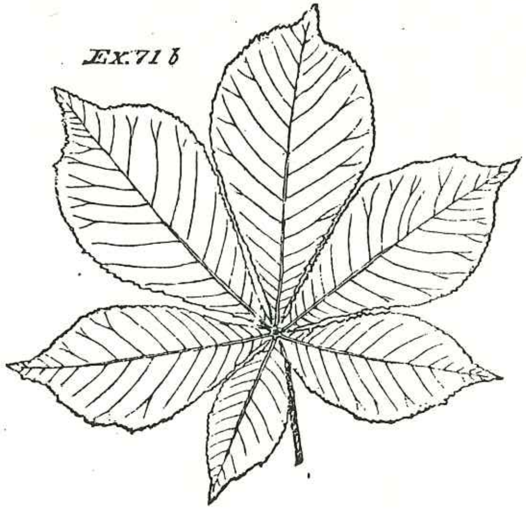
**Ex. 64.** Sixteen Concave Figures United. — Reproduce Ex. 61, except the eight side dots near the centre. Finish as in the example. It will be well for the pupil to make other figures of his own invention, using the dots of Ex. 61.

Questions. — How may a line be best divided into ninths? Into twenty-sevenths? Into eighths? Into sixths? Into eighteenths? Into twelfths? Starting with thirds, and alternating with halves, what do we obtain? How may seven equal spaces be best obtained? Eleven? Nineteen? What is a prime number? Composite? Give examples.

**Ex. 65.** Laburnum Leaf. — The width of this leaf, which is greatest at the centre, is a little less than one-half its length; that is, the leaf is about 3 × 7. Making five dots, beginning with the central, to indicate these proportions, and joining the dots by straight lines, we have a rhomb, as seen in *a*, for the straight-line model of this leaf, and of all leaves which possess the same general form. Sketch the curved lines, which can be easily done by the aid of the straight lines, and we obtain the general outline of the blade of the leaf. Erase, draw the curved lines heavy, add the midrib, and we have *b*. Finish by the addition of the veins, as in *c*. This makes three steps. Do the drawing on a large scale.

**Ex. 66.** Other Leaves on the Rhomb Model. — It will be found, from observation, that a large number of leaves are formed on the laburnum or rhomb model. The first in this exercise is an apple-leaf. Proportions about 8 × 15; that is, greatest width a little more than half the length. In drawing the blade, proceed as with the last exercise, varying the position of the dots somewhat. The petiole, or leaf-stem as it is called in common speech, may be added when the midrib is drawn. The second is a bay-leaf. Proportions about 2 × 5; that is, the greatest width less than half the length. Place the proportional dots accordingly. The third is a rose-leaf, about 3 × 4.

**Ex. 67.** Horse-Chestnut and Beech Leaves. — In this exercise the first leaf is that of the horse-chestnut. Its greatest width is about one-half its length, and is found at about one-third of the length of the leaf from its point. Make the proportional dots accordingly; join these dots by straight lines, and we have a straight-



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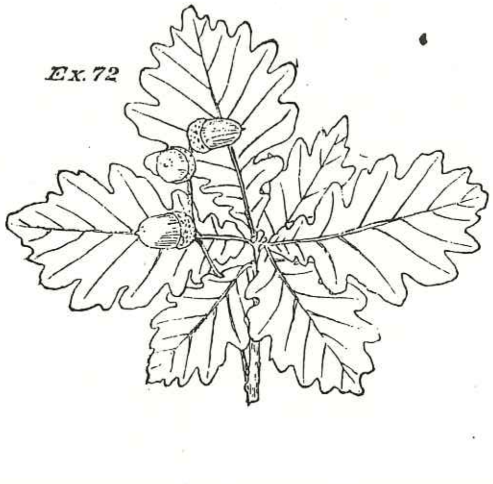


Ex. 72

line model, as in *a*. By the aid of the straight lines, sketch the curved outline of the leaf, and finish as in *b*. The second leaf is that of the beech, which has just about the same proportions as the horse-chestnut. The widest part, however, is towards the base, and not towards the point of the leaf. Having made a right-line model, as for the horse-chestnut, sketch and finish. A large number of leaves are fashioned on this model.

**Ex. 68.** Maple-Leaf. — The base of the maple-leaf is not quite so wide as the greatest width of the leaf, which is near its centre. The height of the leaf is about the same as its greatest width. Place the proportional dots accordingly, as in *a*, beginning with the central one. Joining these dots by straight lines gives the straight-line model. Sketch the outline of the leaf, as in *a*, and finish by the addition of ribs and veins, as in *b*. Many leaves have these general proportions.

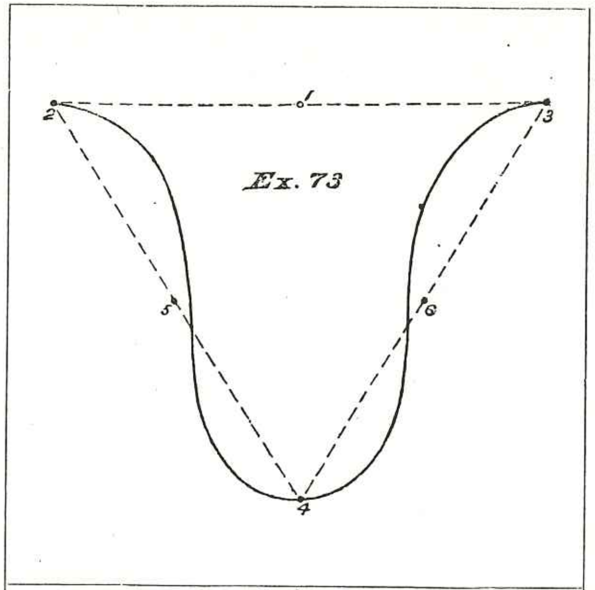
**Ex. 69.** Grape-Leaf. — Make a right-line model, as in the last exercise. To this add the general framework of the leaf, as in *c*, and finish as in *d*. Find other similar leaves, and make drawings of them.

**Ex. 70.** Three-Bladed Leaves. — In the preceding exercises only simple leaves and leaflets have been considered. In this exercise we have illustrations of compound three-bladed leaves. The first is the laburnum, the second the blackberry. Having determined the general relation of the leaflets by dots and straight lines, draw each according to previous directions. Very many triple leaves may be drawn from the straight-line model, *a*.

**Ex. 71.** Six-Lobed Horse-Chestnut Leaf. — At different periods in the growth of the horse-chestnut leaf the number of its lobes, blades, leaflets, whatever one may choose to call them, varies. It will be seen that this has six lobes. In drawing this leaf, first determine the general relation of the different lobes to each other by dots and straight lines, as in *a*, then draw each lobe according to Ex. 67. Result as in *b*.

**Ex. 72.** Acorns and Leaves. — This to be done in a manner similar to the last exercise.

All these drawings of leaves should be executed by the pupil on a much larger scale than the given examples. By carefully placing the dots in the proportional models, the drawings may with ease be enlarged on the blackboard to one or two feet. Leaves of various kinds should also be gathered by the pupil, and drawings of them



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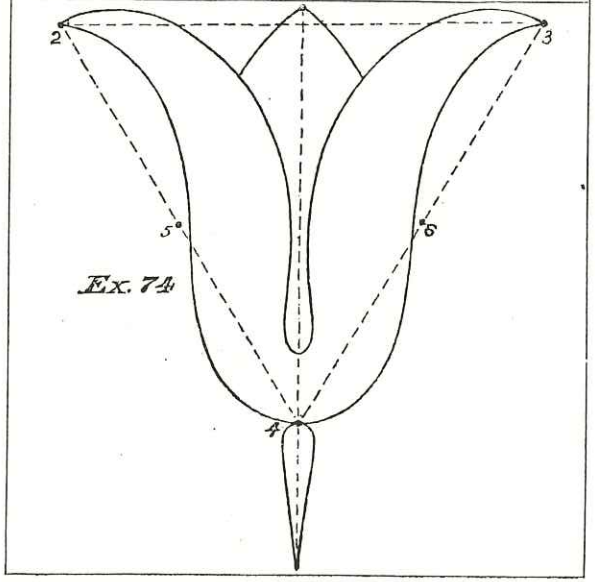


Ex. 74

made. If they cannot be drawn according to any of the general models given, then he should originate models of his own. Though no two leaves are just alike, yet it will be found, on examination, that they are all fashioned on a few simple models. When studying Botany, as all children should, both for pleasure and profit, their progress will be more intelligent and rapid if they are required to make drawings of the leaves and flowers.

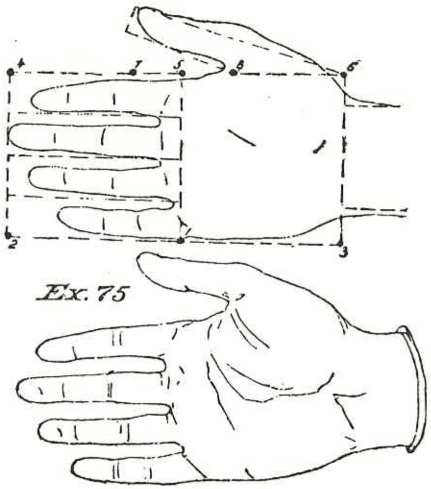
This drawing tends also to a direct industrial result. It is from a study of the growth of leaves and flowers, and the arrangement of their various parts, that many of the best principles of design, of ornamentation, have been deduced. While the forms of nature should not be exactly imitated in industrial art, yet her methods, the way she points out, should be studiously followed. Something more of this farther on.

**Ex. 73.** Compound Curves. — Make the dots in the order of the figures and at equal distances from each other; so that when they are joined by straight lines the result will be an equilateral triangle, — a figure with three equal sides enclosing three equal angles. The curves are no parts of circles, and so cannot be drawn with compasses. Observe that there is no sudden change of direction where they cross the straight lines, as there would be if drawn with compasses, but a very gradual change, which gives a much more beautiful curve. By the aid of the straight construction-lines it will be quite easy making these compound curves alike. After the curves are drawn, erase the construction-lines.

An angle is the difference in direction of two lines, whether they meet or not. If they meet, the angle is called, in common speech, a corner. The teacher will explain the three kinds of angles.

A straight line is monotonous and disagreeable, because it keeps the same direction in all its length. In a less degree, a true circle is monotonous and disagreeable, because it has the same degree of curvature in all its parts. It is the least beautiful of all the curves. The higher and more beautiful curves are used in the best industrial art. It is essential that the pupil should learn to draw the higher curves, of which an example is given in the present exercise.

**Ex. 74.** Flower Design. — This is a simple design suggested by a flower, not an exact imitation of nature; which would be bad industrial art, whatever else might be said of it. Reproduce the last exercise, and then, by the aid of the upright construction-line, finish the curves. Erase the construction-lines.



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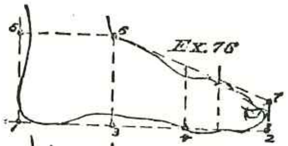

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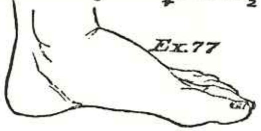

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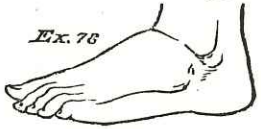


Ex. 78

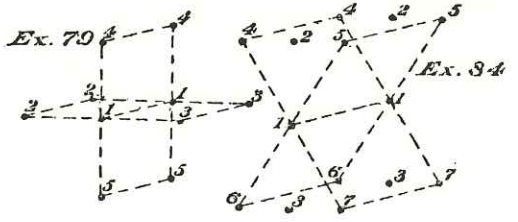
**Ex. 75.** The Hand. — The hand is twice as long as wide. From the wrist to the end of the middle finger, its length is three times that of the nose, or the length of the face. From the wrist to the division of the fingers is about one-half its length. The thumb is one nose long, or one-third the length of the hand, and extends along the central third of it. The middle finger is straight, the others inclining towards it. Make the dots to indicate these proportions, which are very nearly accurate. The distance from 2 to 4 is the same as from 1 to 2. Dots 7 and 8 divide the length of the hand into three nearly equal parts; 7 marking the end of the thumb, 8 the second joint. Sketch and finish. Repeat several times.

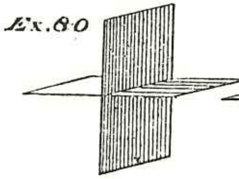
Questions. — What of the general forms of leaves? Describe some of their models? In order to make enlarged drawings of leaves, what must first be done? What has the drawing of leaves and flowers to do with industrial art? Should nature be exactly copied?

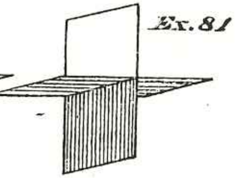
The teacher will observe that usually the questions are not placed with the exercises where the answers are to be found. This separation is from design. The questions are mainly for review, and it is expected the pupil will be able to answer them at any time. The teacher should ask these questions, and others that may occur to him, from day to day and week to week, until the pupil has not only learned their purport beyond the possibility of forgetting, but has learned to practise the things to which they call his attention, — to practise them from the force of habit.

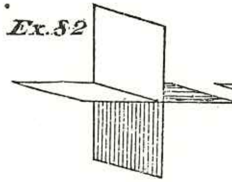
Having learned how to do a thing, we continue to extend our learning by persevering in doing it. So some one has said. It is an excellent motto for him who is learning to draw. Do the same thing again and again.

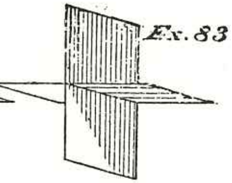
**Exs. 76, 77, 78.** The Foot. — The foot is about five noses long, and two noses wide in its widest part. The great toe, not including the ball, is one nose long. From the rear edge of the heel to the ball of the great toe is two-thirds the length of the foot. From the bottom of the heel to the union of the ankle with the foot is about one-third the length of the foot. Make the proportional dots accordingly. Dots 3 and 4 divide the foot into thirds. The distance from 1 to 5 is the same as from 1 to 3. Ex. 78 is drawn in a manner similar to Ex. 77. Repeat until the proportions are fixed in the mind.

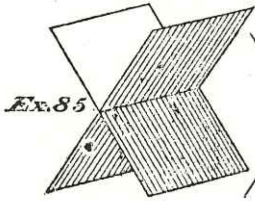


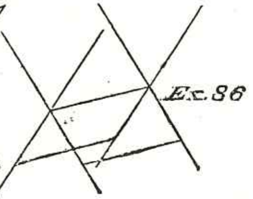












**Ex. 79.** Make the first five dots of Ex. 1; then, at any convenient distance to the right, and a trifle higher, make five other dots in like manner. Unite the dots numbered the same.

**Ex. 80.** Two Intersecting Planes. First View. — Let the lines sketched through the left five dots of the last exercise represent the front edges of the planes, and draw them full.

The shading of this figure represents real shadow. Light is usually regarded as coming from the left, and from a point somewhat higher than the object upon which it falls. So in this case.

**Ex. 81.** Two Intersecting Planes. Second View. — This time let the lines sketched through the right five dots of Ex. 79 represent the front edges of the planes. Finish accordingly.

**Ex. 82.** Two Intersecting Planes. Third View. — For these planes make the right five dots lower than the left five. Take the lines through the right five dots for the front edges.

**Ex. 83.** Two Intersecting Planes. Fourth View. — Make the dots as in the last exercise. Take the lines through the left five dots for the front edges. Is this shaded correctly?

**Ex. 84.** Sketch of Two Intersecting Oblique Planes. — Make the dots in the order of the numerals; 2, 1, and 3 in a vertical line, and at equal distances from each other; 4 and 5 in a level line with 2, and at the same distance from it; 6 in a straight line with 1 and 5, also with 3 and 7. By the aid of dots 2 and 3 the spread of the planes is easily obtained.

**Ex. 85.** Two Intersecting Oblique Planes. — Finish in heavy line the last exercise, and shade.

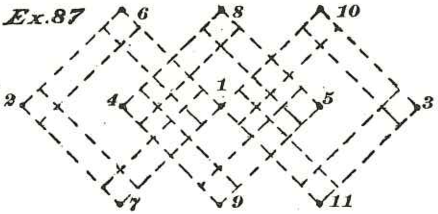
**Ex. 86.** Single-Line Saw-Horse. — From Ex. 84.

The teacher should illustrate Exs. 80–85, as he readily can, by the use of two pieces of pasteboard. Cut a notch half way across each, and put together, showing intersection and shadow.

It will be observed that, in drawing these planes, no regard is paid to perspective. We have simply the vertical projection of an orthographic drawing, and not a pictorial projection, otherwise called a perspective drawing. More of this by and by.

The difference in the direction of two lines, whether they touch each other or not, is called an angle, as heretofore stated. The angle formed by two planes is called a diedral angle. If the two

Ex. 87



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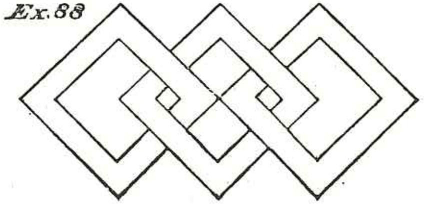
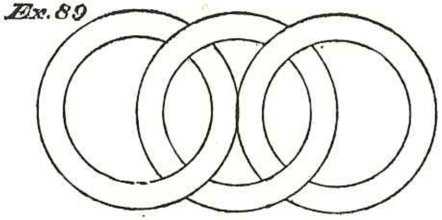
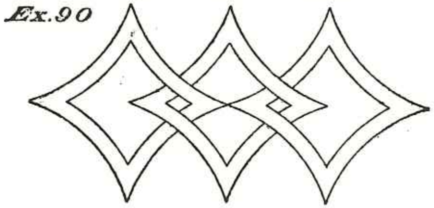


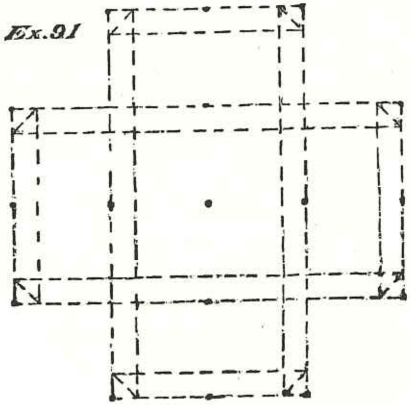
Ex. 89



Ex. 90



Ex. 91



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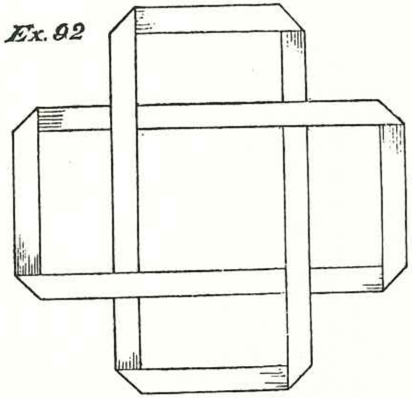
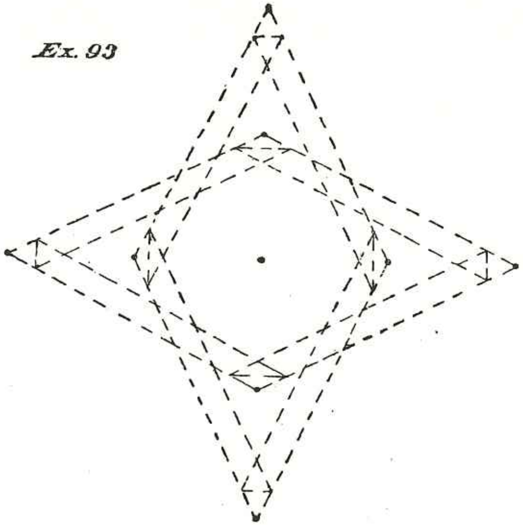
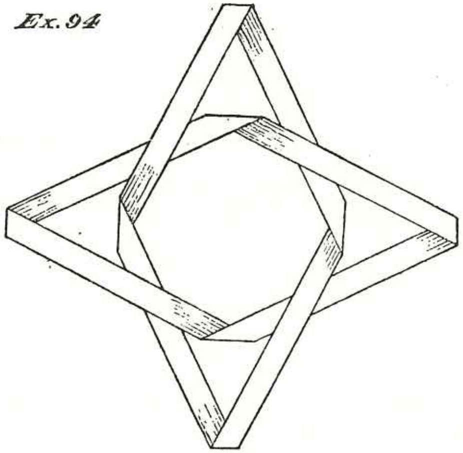


*Ex. 93*



*Ex. 94*



planes are perpendicular to each other, and intersect as represented in Ex. 80, they form four right diedral angles.

A vertical or upright line is always perpendicular, but a perpendicular line is not always a vertical line. When one line meets another at right angles, each is said to be perpendicular to the other, no matter what their direction with regard to a horizontal line.

**Ex. 87.** Make the dots in the order of the numerals. Sketch all the outer lines of the squares first; then the inner.

**Ex. 88.** Three Interlacing Squares. — Draw the last exercise in heavy line, first erasing parts not to show.

In this exercise we not only have double lines, but interlacing, which are so largely employed in ornamentation of different kinds. Thus far we have worked almost wholly with single lines. By the use of double lines and interlacing we can make a greater variety of figures, and more beautiful ones.

**Ex. 89.** Three Interlacing Rings. — Begin with dots of last exercise. Make full sketches of the circles, doing the outer before the inner. In like manner draw the links of a chain.

If the pupil finds this exercise hard to do, it will be well for him to give it a half-dozen trials. Practice alone will make him master of the circle. Perhaps some may find it necessary first to unite the dots by single straight lines, like the outer in Ex. 87. See Ex. 54.

**Ex. 90.** Three Interlacing Curved Figures. — Use the same proportional dots as in the last two exercises.

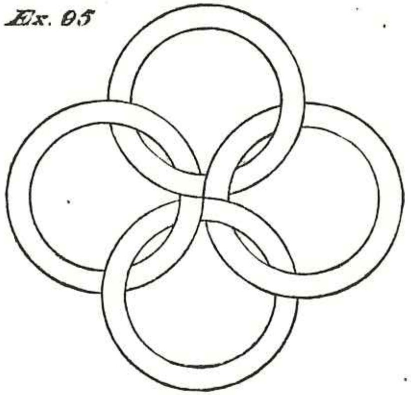
**Ex. 91.** Folding and Interlacing. — This sketch is for two pieces of ribbon or strips of paper, folded and interlaced. Begin with the seventeen dots of Ex. 21. Sketch the outer lines first. Connect the points near the corners, where the inner lines cut the outer; these short diagonal lines show the direction of the folds.

**Ex. 92.** Two Interlacing Parallelograms made of Ribbon or Paper. — Make a sketch as in the preceding exercise. Erase the corners, the parts covered by the interlacing, and the alternate ends of the inner lines. Illustrate with a slip of paper. Fold under to the right each time: that will give the example.

**Ex. 93.** Make a single-line sketch of two diamonds, as in Ex. 7. Add inner parallel lines, then short diagonals.

**Ex. 94.** Two Interlacing Diamonds Made of Ribbon or Paper. — Finish the last sketch.

Ex. 95



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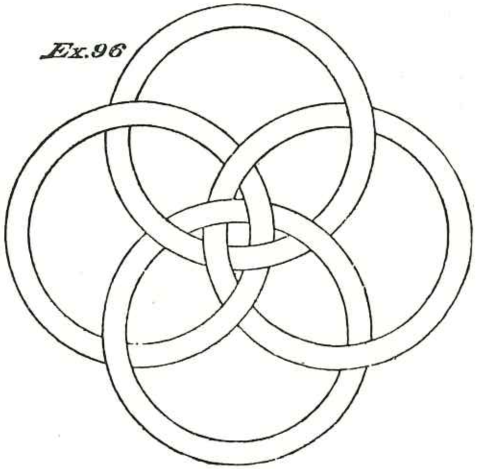

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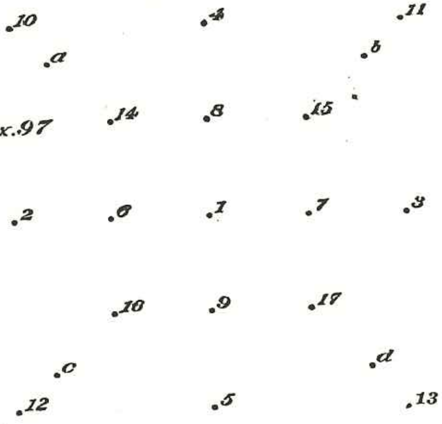

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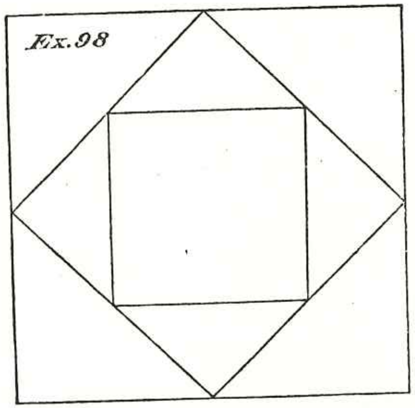
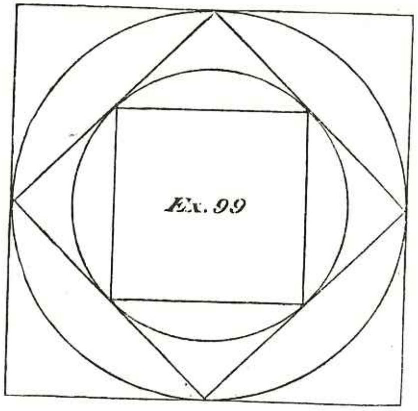
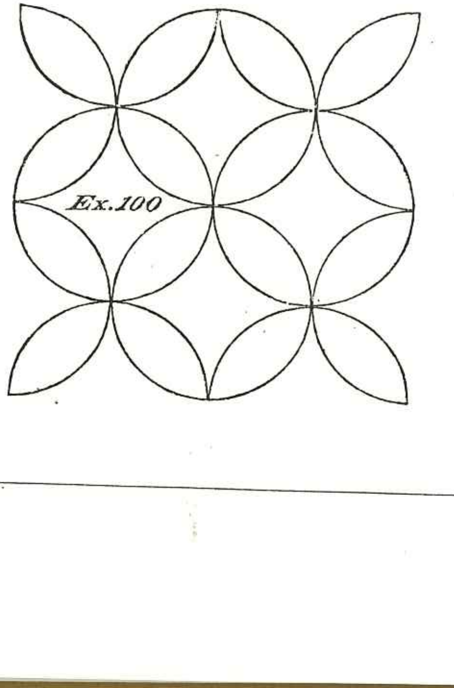




Ex. 99



Ex. 100

**Ex. 95.** Four Interlacing Rings. — Sketch four circles as in Ex. 54. Within these circles, which represent the outer edges of the rings, sketch other circles for inner edges. Erase and finish.

**Ex. 96.** Four Interlacing Rings. Second Order. — Reproduce Ex. 54. Outside each of the four circles thus obtained sketch another and parallel circle; then outside the last sketch a third. Erase the circles first made, and finish. By sketching three parallel circles, the two for the edges of the ring may be readily got.

Questions. — What is the length of the foot? Great toe? Distance from rear edge of heel to ball of great toe? From bottom of heel to union of ankle with foot? Width of the foot?

**Ex. 97.** Twenty-One Dots for Three Concentric Squares and Octagon. — Make the nine dots of Ex. 1; add dots 10, 11, 12, 13 to indicate the corners of a square; then dots 14, 15, 16, and 17 half way between the central dot and the corner ones. Finally make dots a, b, c, d, just as far from dot 1 as dots 2, 3, 4, 5, are from 1. Dots a, b, c, d, with 2, 3, 4, 5, mark the corners of an octagon. As this exercise forms the basis of a large number of drawings, the pupil should practice it until he can make all the dots readily from memory, and with a near approach to accuracy.

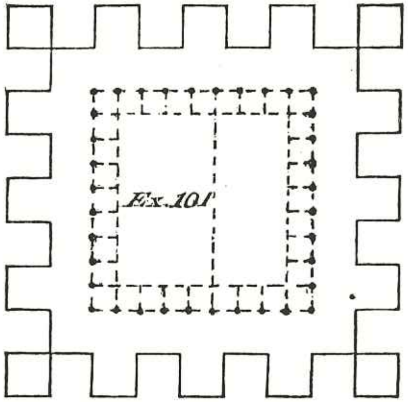
**Ex. 98.** Three Concentric Squares. — Reproduce last exercise, except the lettered dots. In this drawing even a slight imperfection is easily detected; a good one, therefore, for practice.

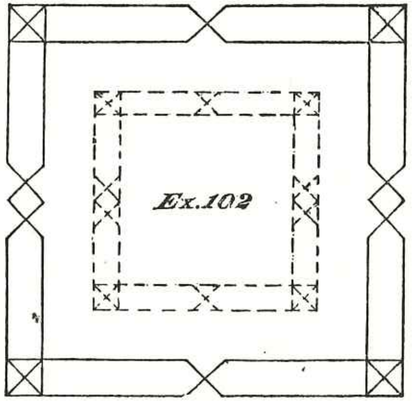
Remember that he who fails to see that his drawing is imperfect, when the imperfection is great, is the only one who need be disheartened. He who readily detects imperfection should be of good courage; for he may be assured that by application he will overcome all obstacles. None are so slow to learn as they who do not perceive their own deficiencies.

**Ex. 99.** Squares Inscribed and Circumscribed by Circles. — Reproduce the last exercise, then add the circles.

**Ex. 100.** Square of Sixteen Ellipsoids. — Use the numbered dots of Ex. 97. Observe that the curves are parts of circles. Much time may be profitably spent on this figure, especially if the drawing is made large.

There are a few persons suffering from physical defect of the eye. For them every thing is distorted. Such cannot draw until their defects of vision have been remedied by glasses, as they may be





**Ex. 101.** GREEK-FRET BORDER. — Make the first thirteen dots of Ex. 97; then erase all but the four corner dots, and through them sketch the sides of a square. Divide the sides of this square into thirds, and each subdivision into thirds again, making nine spaces on a side. Sketch interior lines parallel to the outer, and then short cross-lines, as seen in the sketch. Erase every alternate division of the lines, and finish. The line across the central part of the sketch is simply to show that the short lines on the opposite sides should have the same direction. Do this exercise several times, varying the number of side-divisions. If the divisions are odd, 7, 9, 11, &c., the corners will be like example; if not, not.

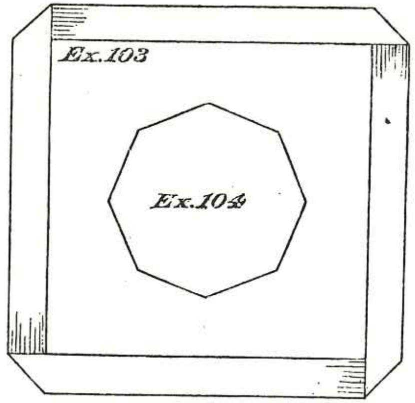
This is the simplest form of what is called the Greek Fret. It is so called, not because the Greeks were the first to use it, but because they used it so extensively and in so many elaborate forms. It is one of the very oldest, if not the oldest, modes of ornamentation known to have been used by man. In one form or another it has been used by nearly every nation and tribe, ancient and modern, civilized and barbarous, and is used by them to-day. One can scarcely turn his eyes in any direction without seeing some application of this ornament to architecture, cloths, table-ware, &c. Further on several modifications of this ornament will be given.

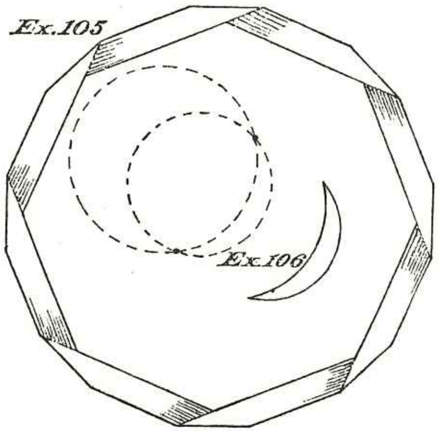
QUESTIONS. — How can the pencil be best sharpened? How should it be held? What about sketching a line before drawing it heavy? What about executing drawings without any erasures? How far should the eye be from a drawing to judge well of all its parts? How many noses long is the head? How would you proceed to make nineteen equal spaces?

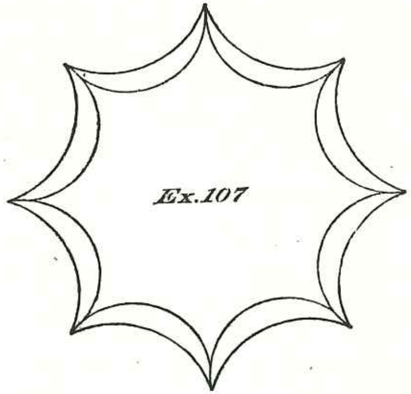
**Ex. 102.** SECOND BORDER. — Sketch the sides of a square, and within and parallel sketch other lines of the same length. The oblique lines introduced in the sides, which should be drawn parallel with the diagonal lines at the corners, break up the sameness.

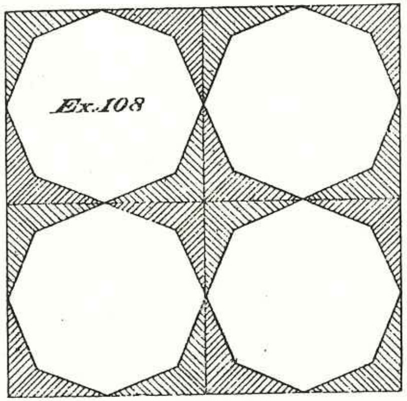
A diagonal is a line which joins two angles of a figure, but not adjacent angles. If the figure is four-sided, like a square, it joins the opposite angles or corners.

QUESTIONS. — What is said of the beauty of a straight line? Of a true circle? Which curves are the more beautiful? How should a compound curve change its direction? What is an angle? An equilateral triangle?

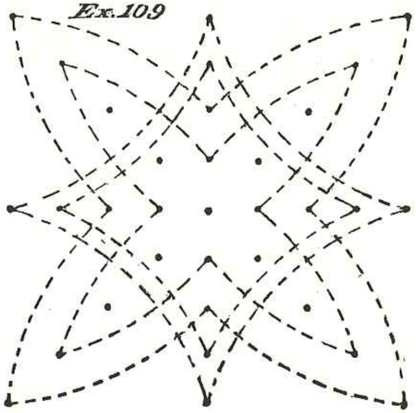

Ex.103
Ex.104


Ex.105
Ex.106

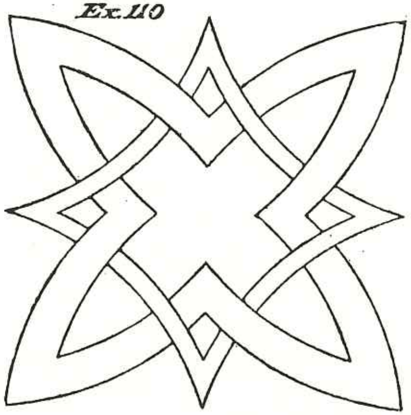

Ex.107


Ex.108

*Ex. 109*



*Ex. 110*



**Ex. 103.** Border of Folded Paper or Ribbon. — Sketch the sides of a square. At any satisfactory distance within, sketch parallel lines of the same length. Finish as in Ex. 92.

**Ex. 104.** Single-Line Octagon. — Make all the dots of Ex. 97; then join those dots which are lettered to those which mark the centres of the sides. It may be thought needless to make so many dots; but on trial it will be found difficult locating the lettered dots properly without the others to guide. This exercise is put within the paper border to save room; the pupil will not so make it.

Questions. What is an angle? A diedral angle? When is a line said to be vertical? When perpendicular? How is light usually regarded as falling on an objected in a shaded drawing?

**Ex. 105.** Octagon of Folded Paper or Ribbon. — Make a sketch of an octagon, as in the previous exercise. Inside and parallel sketch another, extending the lines until they cut the sides of the outer. If further directions are needed, turn to Ex. 92.

**Ex. 106.** Single Crescent. — It has been said that in order to draw a part of a circle correctly it is best to draw a whole one and then erase what is not wanted. Do so in this case, having first made two dots to mark the points of the crescent.

**Ex. 107.** Eight Crescents United. — Make a sketch of an octagon, as in Ex. 104, and on one of its eight sides sketch a crescent, as in Ex. 106. Taking this as a standard, sketch the other seven crescents from it without first sketching the circles. Finish.

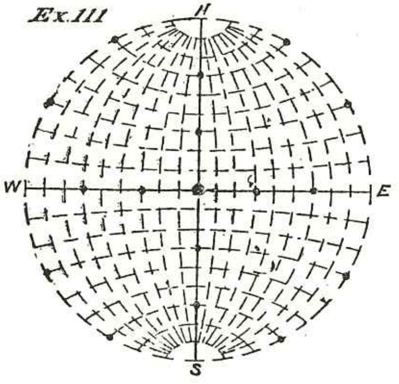
**Ex. 108.** Octagon and Star Design. — Make the numbered dots of Ex. 97, and sketch the lines for four squares. Add the other dots required to make an octagon in each of the squares. Dots 14, 15, 16, 17 are the centres of the octagons. By increasing the number of the squares, the drawing may be readily enlarged.

**Ex. 109.** Begin by making the numbered dots of Ex. 97; then halve all the vertical, horizontal, and diagonal spaces. Sketch the outer lines before sketching the inner and parallel ones.

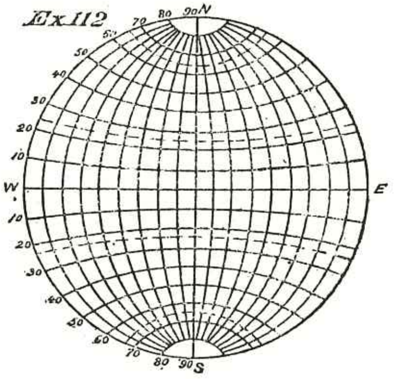
**Ex. 110.** Erase needless parts of last exercise, and finish.

Questions. What is an octagon? What is a diagonal? Who alone has reason to be discouraged in learning to draw? What is said of the Greek-fret border?

Ex.111



Ex 112



**Ex. 111.** Reproduce Ex. 2, beginning with dot 1, of Ex. 1. The horizontal line will represent the equator, the vertical line the central meridian of the map. Sketch a circle touching the ends of these lines. Divide each quarter of the circle, or quadrant, into thirds, as indicated by the dots in the example; also each half of the vertical and horizontal lines. Divide into thirds again, when each space thus obtained will correspond to ten degrees. First sketch the lines from left to right, — that is, the lines of latitude; then the lines from top to bottom, — that is, the meridian lines. Before sketching the latter, it may be found well to divide a line of latitude on each side of the equator, and about half-way to the poles, just as the equator itself was divided.

By first dividing into thirds, next into halves, the spaces will equal fifteen degrees, the distance the sun travels in one hour.

Though it will require considerable time to do this exercise, yet it will not be found difficult. Measure only with the eye.

**Ex. 112.** Globular Map. — Reproduce the last exercise, and finish. The meridian lines of this and the last exercise may be extended to the poles, if thought best. The sketched lines represent the boundaries of the zones, of which a separate map should be drawn, with only the lines necessary to bound them. This may be readily done by proceeding as in the last exercise until you come to the drawing of the meridians and lines of latitude.

Having first made a drawing, as in the present exercise, the outline and more prominent features of any continent or country may be readily added. Indicate by dots the leading points, and then unite them. Teachers find dots more convenient than lines in any form of free-hand map drawing. When at work with geography, the pupil should have constant practice in drawing rude outline-maps.

Draw two globular maps side by side, representing the eastern and western hemispheres. The teacher will explain the meaning of the geographical terms employed in this exercise and the last.

**Exs. 113, 114, 115, 116.** Profile Views of the Eye, Mouth, Nose and Ear. — Observe the peculiar line that separates the lips, and that the nostril extends only about one-half beyond the upper lip. The ear is twice as long as wide. Divided into thirds crosswise, the central third gives the cavity in the head. Observe the peculiar shape of the lower lobe. For further instructions, read what is said under exercises 49, 50, and 51.

**Ex. 117. a.** PROFILE SKETCH OF HUMAN HEAD. — Make the first five dots at equal distances apart, and then dot 5 as far from 2 as dot 3 is from 2. Sketching the horizontal and vertical lines, we have a square divided into four equal rectangles. Place dot 7, to indicate the depth of the head, on the central line. It will be seen that the greatest depth of the head, which is somewhat less thanits length, is just above the ear. Draw first the outline of the head; then add the different features. Ear about two-thirds of the way back from the front. Read what is said under exercises 47 to 52, inclusive.

**Ex. 117. b.** PROFILE VIEW OF A MAN'S HEAD. — Remove the construction-lines of the last drawing, and finish.

**Ex. 118.** PROFILE VIEW OF A BOY'S HEAD. — This is drawn from nature, being the head of a boy six years old. Begin with construction-lines, as in the last exercise; but observe that something more than half of the head is above the ears, and make the construction-lines accordingly. Children usually have more than half the head above the ears, their jaws not being proportionately developed. The same is true of women, only in a less degree; while the opposite is usually true of men.

Here ends the first part of this book. A good day's work each day for twenty weeks will bring pupils ten or twelve years old thus far. To a limited yet important extent, the eye has now become skilled in seeing, the hand in executing. What was first done from effort and with awkwardness is now done from habit and with grace. What was slovenly done is now done with neatness and method. The instructed invention has learned how to originate. Future progress will be vastly more rapid and delightful.

"Want of care," says Franklin, "injures us more than want of knowledge." Drawing, properly practised, trains one to be careful, neat, and methodical. Good working materials are a great help to this end. For these exercises, a long pencil, of medium hardness, is needed, and paper specially adapted to the exercises, such as the publishers of the book have provided. On each sheet of paper the pupil should write his name, date, and time spent on the drawing. Whether done at home or in school, the drawings should all be passed to the teacher, by him to be examined and ranked, if that is his custom, and kept for the inspection of visitors and school officers. At the end of the term the drawings are all returned to the pupil.

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**No. 1.** This sheet is about four inches square. It has been found, by trial, that this is quite large enough for the younger pupils, when they begin to draw on paper, and for some time afterwards. With due allowance for margin, it permits a line about four inches long in some directions to be drawn. Price per package, 20 cents.

**No. 2.** This sheet is some five or six inches square. Older pupils, and the younger ones after considerable practice, should use a sheet of this size. In free-hand practice, it is not often necessary to draw a longer line than can be drawn on a sheet five or six inches square. Price per package, 30 cents.

If there is no waste of paper, and if the drawings are executed but once, two packages will be enough for all the drawings in the book, as quite a number of the 250 are of such a form that two or three can be put on a single sheet. But many of the drawings should be done several times, while there will be some waste; and so, by the time the younger pupils have made progress sufficient to use the larger sheets, the first package or two will be consumed. Children learning to draw should not be stinted in paper.

Every drawing should be preserved, — the sheets stitched together, or pasted in a scrap-book.

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EDITED BY

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